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THE LAPPS AT THE GARDEN OF ACCLIMATIZATION.

For a few years past the Garden of Acclimatization, at Paris, has had on exhibition, from time to time, specimens

Fig. 1.—LAPPS AND THEIR SKATES.

of some of the more curious peoples of the world; such, for instance, as Nubians, South American Gauchos, Eskimos, etc. This year, just as the cold weather was beginning, M. Saint-Hilaire succeeded in introducing a party of Lapps. The interest and utility of such ethnographic exhibitions is incalculable; for thereby both the young and old members of the public acquire correct notions in regard to exotic peoples and races. So in the present instance, the exhibition of the Lapps, following that of the Eskimos, has had the effect of disabusing people's minds of that too prevalent erroneous idea that these two races are identical.

Although both Lapps and Eskimos are of short stature, yet from an anthropological standpoint they differ in one most important character—that of the shape of the head. While the Eskimo has a longer cranium than any other human race known, the Lapp has a very short one; or, scientifically speaking, he is *brachycephalous*. Lapps and Eskimos differ in many other points, too. The latter are essentially hunters, especially fishermen; their element is the sea; marine animals — seals, morses, whales, and fishes constitute their sole resources; finally, taken in their natural state and outside of all influences of other nations with which they have come in contact, they really have not yet passed the "Stone Age." It is quite otherwise with the Laplander; from time immemorial (that is much before the beginning of historic times in Northern Europe) he has known the use of copper and bronze, as well as the art of working them. It seems, however, that he has learned this art from the Scandinavians, from whom the Lappish language has borrowed the names of different metals.

The Lapp has passed beyond the savage state, characterized by hunting and fishing as a principal means of existence; he is a shepherd, and if the rough nature of his country does not allow him to raise many kinds of animals, he finds at least in his herds of reindeer sure and abundant resources against the difficulties of life. The Lapp, then, taken altogether, occupies a place a degree higher than that of the Eskimo in the scale of human races.

A simple glance at the exhibition of Lappish manufactures, in the buildings of the Garden of Acclimatization, will convince any one of the immense superiority of this race over the poor seal hunters of polar America. Their jewelry, consisting of ornaments chiseled, *repoussé*, and engraved with a peculiar style of art, exhibits an originality of taste greatly to be recommended because of its simplicity. Most of their clasps consist of two lozenges (Fig. 4, No. 1) placed end to end and united by rings that are hidden by an elegant little open-work flower-shaped button, very artistically fashioned. On the surface of each lozenge are other buttons in *repoussé* work, placed in geometrical patterns. Several of their clasps or buckles are likewise ornamented with small, lozenge-shaped pendants, attached by small chains. Some of their brooches consist of a large thick ring, from which hang three open-work disks or wheels (Fig. 4, No. 4). This jewelry reminds us singularly of the antique ornaments that have been discovered in the *tumuli* of Northern Asia. The potter's art is also known to the Lapps, although their pottery is of a coarse paste and less elegant in form than their jewel work. As an offset to this, however, they are skillful workers in wood, and produce very curiously sculptured utensils; we represent herewith (Fig. 4, No. 6) a carved wooden spoon, which exhibits considerable taste. From the bark of the birch trees, which form dense forests in the interior of Lapland, they fashion thousands of light and useful objects. In the collection under consideration are exhibited a game-bag and some bags or baskets of silvery bark, which are charming to the eye, and which must be very convenient (Fig. 4, No. 8).

The national clothing of the Lapps was originally composed of skins and furs, principally those of the reindeer, and prepared and tanned by very ancient processes. In the present collection may be seen a bone knife (Fig. 4 No. 5) used in preparing skins, and the form of which was perpetuated in metal when, at a later period, the Lapps began to use such materials. In the beginning of the present century they used also, in some localities, chisels or scrapers of stone for detaching the hair from the skin of the reindeer. However, contact for a long time with the more civilized Finns and Scandinavians has made known to the Lapps fabrics of woolen, and these they make use of at the present day for summer clothing and ceremonial vestments. Still, to the eyes of Europeans, the fashion does not appear to have changed, and the Lappish clothing of woven fabrics seems to us to be modeled after the ancient clothing of fur

Fig. 2.—LAPPS AND THEIR SLEDS.

The costume, which is about the same for both sexes, consists of pantaloons and a blouse fastened about the waist with a leather belt. The beautiful cloth garments, especially those for young girls, are of dazzling colors, scarlet, red, blue, and yellow; and the girdles, instead of being a simple leather strap, are masterpieces of many-colored embroidery, loaded with copper ornaments of very original forms (Fig. 4, Nos. 2 and 3). But their work and fatigue dresses are of reindeer skin, the hairy side outward. The male head covering consists of a high, square, black or blue cloth cap, somewhat resembling the Polish *chapska*. This head dress, which in winter is ornamented with fur, is relieved by a band of red cloth at the base. The style of bonnet worn by the young women is very peculiar. It consists of a head-band, hermetically enveloping the cranium, surrounding the face entirely, kept in position by wide bands, and terminating at the top in a helmet-crest, like a Phrygian bonnet; the upper part is of cloth of a red or other gaudy color, and this is crossed by the fastening bands, which are always of a different shade. Older women cover their heads with a simple little low cap. In winter the Lapps put on a heavy tippet of bear skin, which covers their neck up to the ears, their shoulders, their back, and breast, leaving their limbs free. In ordinary weather they wear immense leather boots, turned up at the toe, and into these are stuffed the ends of the pantaloons. In winter they make use of skates for gliding over the snow (Fig. 1); these are narrow strips of wood over three feet long, and in the middle of each of which is a copper ring through which the foot is passed. By the aid of this foot protection, and a long stick, the Lapps make long excursions over their ice and snow covered country; without such precautions they would sink in the snow up to their necks.

As regards weapons, the Lapps long ago discarded their old arms and adopted the gun. But the style of weapon they use is the old musket in vogue among our ancestors. Still they are none the less good marksmen for all that, as the fur-bearing animals of Lapland learn to their cost. Every individual, from the age of three years up, carries suspended from his belt, in a

Fig. 3.—LAPPS—MALE AND FEMALE—AT THE GARDEN OF ACCLIMATIZATION, PARIS.—From a Photograph.

leather sheath, a strong, thick oladed knife, which serves for all domestic and other uses. The Lapp possesses, too, a special talent for throwing the lasso, like the South American Indian. It is by this means that he catches the refractory reindeer from his herds when he needs him, either to harness to his sled or to butcher for his kitchen.

The art of saddlery is in a very primitive state in Lapland, the bit and bridle being entirely ignored; a simple halter serves to direct the course of the reindeer, whose deviations from the right path are corrected by beating him with a heavy club. The entire harness consists simply of a strong girth, to which is attached a single traces-strap passing beneath the belly of the animal and fastened to the fore part

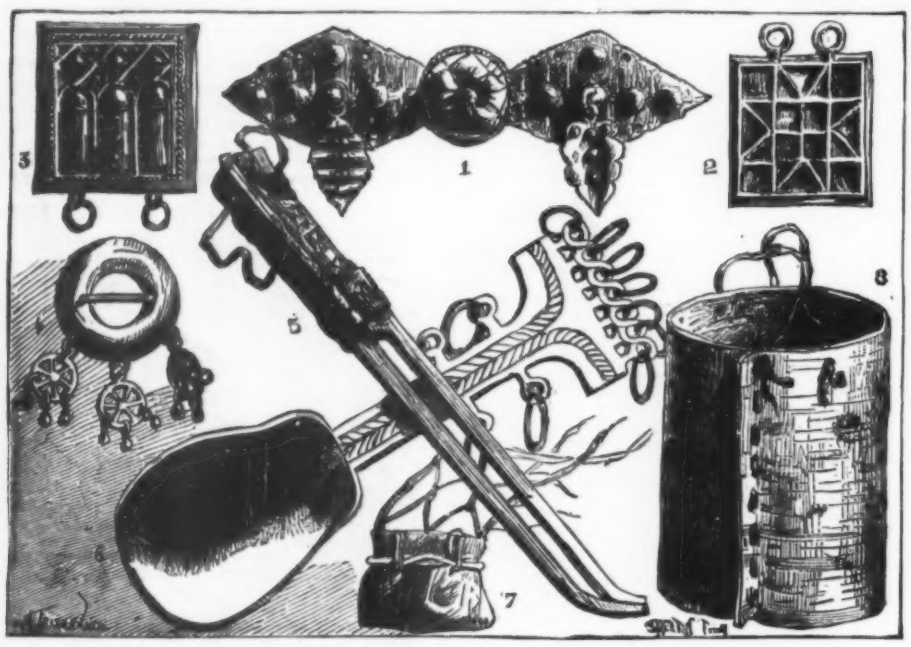


FIG. 4.—VARIOUS OBJECTS OF LAPP MANUFACTURE.

of the sled. The latter is a very narrow, canoe-shaped vehicle, capable of seating but a single individual (Fig. 2). Reindeer constitute the principal riches of the Lapp. To be considered in easy circumstances, a single family, consisting of husband, wife, and one child, must own a hundred of these animals. With fifty a bachelor can safely retire from business, but whoever possesses less than this number thinks it necessary to work for his living in the service of some wealthy individual. Reindeer not only furnish the Lapp with his clothing, but also constitute the base of his food supply. The thick and creamy milk, both in its pure state and in that of cheese, forms a precious resource. The flesh of the animal is eaten both fresh and smoked, and is said to be very palatable. The blood goes to form a highly-prized national dish called *malsupta*, or "blood soup."

During the pleasanter seasons of the year the Lapps lead a nomadic existence, camping and decamping incessantly; so the form of their dwellings is perfectly adapted to this kind of life. Formerly their tents were covered with reindeer skins, but at present they use for this purpose either tarred sail cloth, purchased from the Norwegians, or else hangings and coverings woven with considerable taste by the coast Lapps. The latter people are more civilized than their kin of the interior, and having adopted a sedentary mode of life, occupy themselves in raising flocks and weaving fabrics. They are also good fishermen. Taking to their large canoes, they put to sea and cast their nets in the waters frequented by those myriads of fishes which migrate annually through the waters of the North Sea. We give an illustration (Fig. 4, No. 7) of one of their net-sinkers. This is simply a stone enveloped in a pouch made of birch bark.

Divided between three very distinct states—Russia, Norway, and Sweden—the Lapps have scarcely any nationality properly so called. They have not even tribal organizations, but live simply in little groups, or *pulks*, composed of a family and its servants, but never very large. They pass for orthodox Christians in Russia, and for Lutherans in Sweden and Norway; but in the main they preserve all their antique beliefs, all their old Finnish superstitions. Their national religion was a polytheism strongly tinctured with fetichism. In mythology, as well as in language, the nomadic Lapps are closely related to the Finns, whose characteristic features, moreover, they possess. Of the latter people they have the globular cranium, broad face, prominent cheek bones, small eyes, short nose, and massive bony structure. Their complexion is yellowish, and their stature is short. Out of the nine individuals now at Paris, a single one only has hair that is truly black; that of all the rest is of some light shade. It is pretended that the blonde Lapps are not of pure blood, and that it is especially those belonging to Russia and Norway that present this mongrel character, while those of Sweden (the majority of whom are brown) would better represent the genuine type of the race. However, when we consider that the Finns are for the most part blondes, and that the Samoyeds are too, and that blondes are found in the majority among the Tartars of Kagan, it becomes difficult to decide whether the original Ouralo-Altaic type was blonde or dark-brown.

TELEPHONE CALLS.

By GEO. M. HOPKINS.

AN efficient signaling apparatus is of almost vital importance to a telephone line, as none of the telephones up to this date are capable of emitting sounds that can be heard at a sufficient distance to attract attention in an apartment of ordinary size.

Among the many forms of telephone call signals, the small magneto-electric machines, with bell attached, seem to take the preference. Such machines are quite expensive, but they possess the advantage of working without a battery.

The machine shown in Figs. 1 to 4 inclusive, is a modified form, in which the revolving electro-magnet or armature is made to do double duty, acting when at rest as an electro-magnet, which, when its helices are traversed by the currents from another similar machine, vibrates the polarized armature which carries the bell hammers. By this arrangement, one bell and two magnets are dispensed with, and the machine is simplified.

The engravings are exactly one half size, and may, therefore, be used as working drawings in the construction of a machine.

Fig. 1 is a perspective view. Fig. 2 is a central vertical transverse section looking toward the side of the permanent magnet, and Figs. 4 and 4A (not made to scale) show the switch and connections.

In Figs. 5 and 6 a different form of alarm is shown, which will be described further on.

To the wooden base, A, is fixed a vertical piece, B, through which, near the top, a hole is made for receiving the tube, C, which forms the bearing for the shaft, G. On the tube, C, there is a collar, D, and it has a nut, E, for drawing the collar, D, so as to clamp the permanent U-magnet, F, firmly against the upright, B. The arms of the U-magnet are parallel, and are separated a little more than is usual in this kind of magnet, to avoid influencing the polarized armature placed between them.

The shaft, G, has on one end a crank, H, by which it may be turned; on the other end there is a grooved wheel, I.

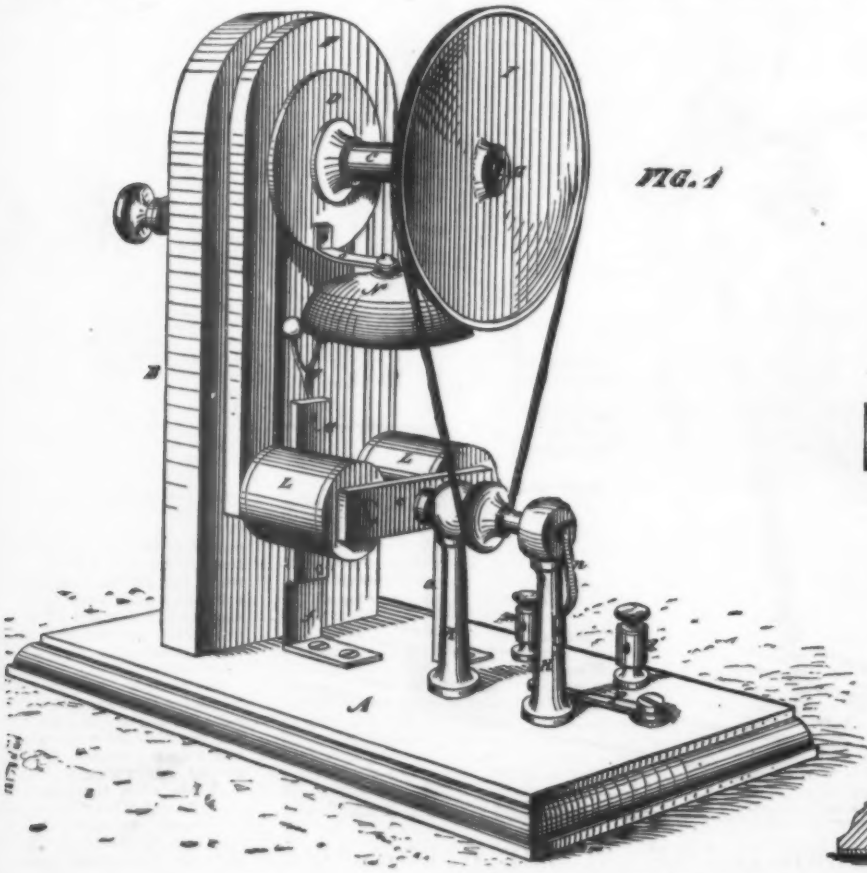
Below the shaft, G, a shorter shaft, J, is journaled in posts, KK'. An armature or electro-magnet, L, is attached to the shaft, so that it will rotate in front of the poles of the magnet, F. The electro-magnet consists of two bobbins of No. 36 silk covered copper wire, wound on ⅝ inch soft iron cores. These cores are secured to the soft iron bar, *c*, by screws. The bar is bored through the middle to receive the end of the shaft, J, on which it is clamped against a shoulder by a nut, as indicated in the engraving.

The bobbins are wound like the bobbins of an electro-magnet, and their outer terminals are connected together; the inner terminal of one bobbin is connected with the bar, *c*, so that it is in electrical communication with the shaft, J. The inner terminal, *a*, of the other bobbin is soldered to a brass sleeve, *b*, that is placed on an insulating cylinder of vulcanite or ivory on the shaft, J.

Half way between the poles of the magnet, F, and exactly even with the face of the magnet, a polarized armature, M, is supported by the L-shaped spring, *f*, attached to the base, A. Two bell hammers are connected with the upper end of the armature, M, by a forked wing.

The bell, N, is supported by a bracket, *o*, so that one of the hammers may strike the inner side of the bell, and the other the outer side. A pulley, *d*, on the shaft, J, receives the round belt, *e*, from the wheel, I.

In the outer end of the shaft, J, there is a V-shaped notch to which is fitted the end of the spring, *n*, which is of a corresponding shape, as will be seen by reference to the detail

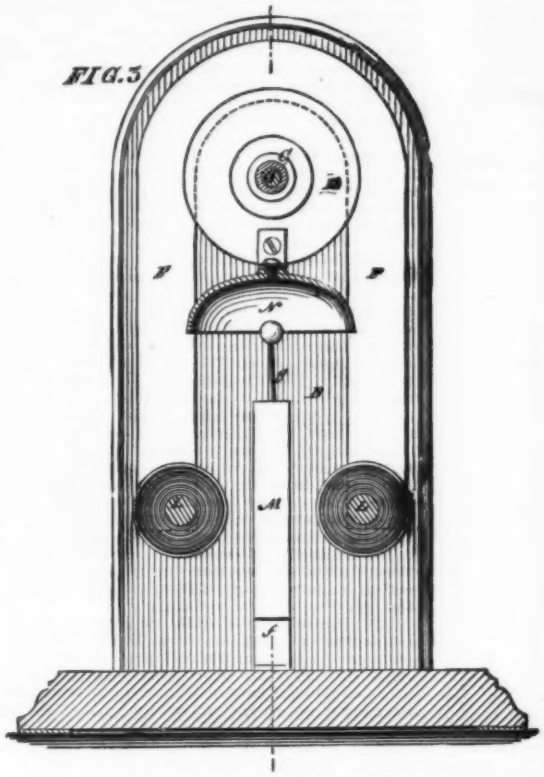


MAGNETO-TELEPHONE CALL.—HALF SIZE.

view shown at the right in Fig. 2. This spring and notch serve to hold the magnet, L, in a vertical position before the armature, M, when the machine is at rest, and it offers very little resistance to the rotation of the shaft.

A spring, O, presses on the sleeve, *b*, and communicates by a wire, *j*, with the switch button, *k*, and the binding post, *m*. The post, K, is connected with the switch button, *i*, by the wire, *i*, and the switch, P, which is connected with the binding post, *l*, may be moved so as to touch either of the buttons, *i k*.

FIG. 3.



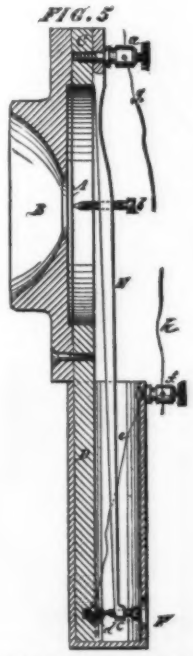
MAGNETO-TELEPHONE CALL.—HALF SIZE.

The line wires which connect with the posts, *l m*, are also connected with the telephones. With the switch in the position shown in Fig. 4 the call is in the line. By turning the machine alternating currents are generated, which, passing through the magnet, L, of another machine cause the polarized armature, M, to be alternately attracted and repelled, so as to bring the hammers into contact with the bell.

After the alarm is given the switch, P, may be moved into contact with the button, *k*, thus cutting out the alarm apparatus. It is obvious that all of the calls on a line should be left in condition for operation, *i. e.*, with the magnet, L, in a vertical position and the switch, P, on the button, *i*.

In Fig. 4A is shown a diagram of connections by which the telephones may be cut out when the call is in the line, and *vice versa*.

FIG. 5.



ELECTRIC TELEPHONE CALL.—HALF SIZE.

FIG. 6.

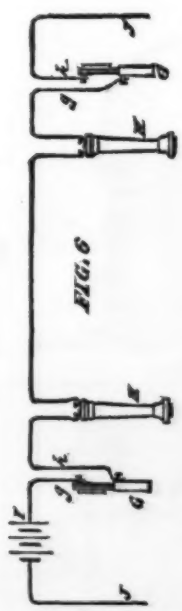


DIAGRAM OF CONNECTIONS.

The switch, S, is pivoted centrally, and is capable of forming connection between the buttons, *d' f'*, or the buttons, *e' c'*. *m*, *l*, are binding posts that receive the line wires; *a' b'*, are posts for receiving the telephone connections. The post, *m*, is connected with the spring, *o*, and with the button, *e'*. The post, *l*, is connected with the button, *d'*, and post, *a'*. The button, *c'*, and post, *b'*, are connected, and the standard, K, and button, *f'*, are connected. When the switch is in the position shown, the alarm apparatus only is in the circuit. When it is turned, so as to connect the buttons, *c'*, *e'*, the telephones only are in the circuit.

Either of these switch arrangements may be used, but the one shown in Fig. 4A is probably the best.

The alarm shown in Figs. 5 and 6 can be used only with a battery and a closed circuit.

The diaphragm, A, is clamped between the mouthpiece, B, and the ring, C. To the latter is attached an arm, D, that extends downward, and is covered by the hollow handle, F. A long wooden spring arm, E, is attached to the ring, C, and extends downward into the handle, F. A screw, *b*, passes through the spring arm, E, and rests against the center of the diaphragm. A platinum pointed screw, *c*, passes through the free end of the arm, E, and touches an anvil, *d*, that projects from the arm, D. The screw, *c*, is connected with the binding post, *a*, by a wire that extends along the arm, E, and the anvil, *d*, is connected with the binding post, *f*, on handle, F.

When this instrument is connected with the line, *g*, *h*, in which is placed the battery, I, and the telephones, H, it answers well for rooms where the noise is not great. By singing or speaking loudly in the instrument the current is rapidly interrupted, and the alarm will be heard from the telephones.

FIG. 4.

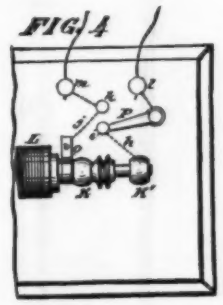
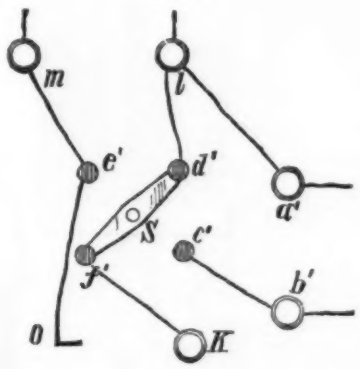


FIG. 4A.



The battery used in connection with this instrument should be adapted to a closed circuit. A gravity battery is probably the best. The number of cells required will depend altogether on the resistance of the line.

With these calls any of the telephones employing permanent magnets may be used.*

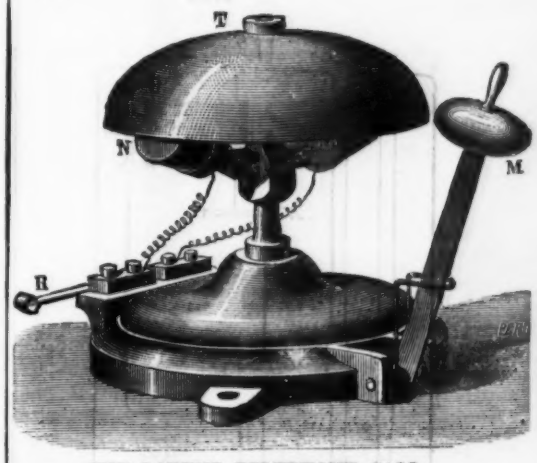
THE LORENZ TELEPHONE CALL.

THE following description of this alarm, or call bell, is taken from the recently published treatise of M. Alfred Niaudet-Breguet, civil engineer, Paris.

The apparatus, represented by the figure, is the transmitter of M. Lorenz. The magnet, N S, is placed coincident with a diameter of the gong or bell of steel, T. When, by means of the hammer, M, pushed by a spring, the gong is struck in a direction across that of the magnet, the vibrations have their maximum amplitude in front of the poles, and induction currents, relatively strong, are generated in the coils placed on the poles of the magnet. These currents are sent to the corresponding station, and are there received in the Bell telephone slightly modified—the bobbins being more powerful than in ordinary telephones, and a resonator being also added to them. This resonator is a long cone of white iron, truncated at its top, the small end being inserted close to the telephone diaphragm.

In order that the resonator should give the best results it should be tuned over the bell of the transmitter, and regulated in length accordingly.

This call gives out sounds easily heard throughout a workshop. We have proved that, with a little attention, it can be heard at a distance of 10 or 12 meters in an open concert hall, and at 5 or 6 meters when the hall is filled with the public. It must, therefore, be admitted that the Lorenz call yields an alarm sufficient for a great number of cases.



THE LORENZ TELEPHONE CALL.

The resonator telephones can otherwise serve for conversation in a similar manner to the ordinary ones. It should be stated that the bell transmitter has a commutator (not well shown in the figure) which puts the apparatus habitually on short circuit. When, therefore, one wishes to call, it is necessary with one hand to press upon the commutator in order to put the apparatus in circuit, and with the other hand to strike the bell with the hammer.

CALL BELL AND MORSE COMBINATION FOR TELEPHONE LINES.*

INSTEAD of the magneto machine and call bell which have already been described in connection with the telephone, a battery and vibrating bell may be, and sometimes are used, for signaling purposes. Fig. 1 represents the connections for an arrangement of this kind. The line wire is joined to the back end of a four point button switch, S. The right hand front contact leads to one end of the helices which surround the bell magnet, and whose opposite end is in metallic connection with the armature lever. In its normal position this lever is held by a spiral spring against the back stop, which is joined to a wire leading to the ground. The middle front point of the switch communicates with one pole of a battery, E, whose opposite pole is in connection with the ground wire, and the left hand point is connected to one or two telephones, T, also in communication with the ground.

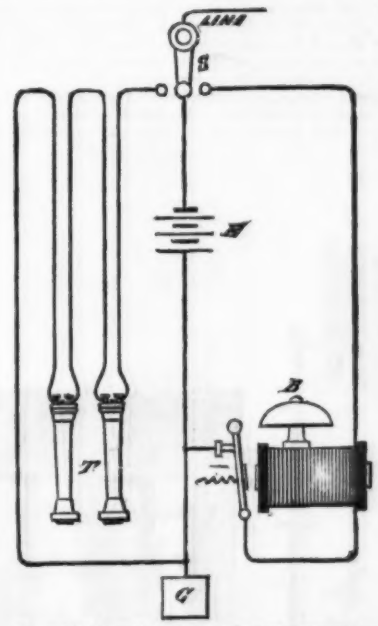


FIG. 1.—CALL BELL FOR TELEPHONE LINE

When the apparatus is not being used, the switch is left on the right hand contact, so that a current coming from the line has a free path through the helices, armature lever, and back stop, to earth The soft iron core is thus rendered magnetic, and attracts the armature, but after the latter has moved a short distance it leaves the spring forming part of the back stop, and in so doing breaks the circuit. The magnetism of the cores consequently disappears, and the armature is drawn back so as to complete the circuit once more, when another attraction follows, and so the process goes on alternating as long as the battery is kept on at the distant station. Each attraction, therefore, occasions a distinct tap upon the bell, and as the magnetization and demagnetization are exceedingly rapid, the taps consequently succeed each other with sufficient rapidity to keep up a continuous ringing.

If the attendant at the distant station is wanted, the switch is placed on the middle contact, which allows the current from battery, F, to pass into the line, causing the distant bell to ring.

* Should any of our readers desire to make their own telephones, they will find full directions in SUPPLEMENT No. 142.

* From Prescott's "Speaking Telephone," etc.

The switch is then turned to the right again, when, if the signal has been observed, an acknowledgment to that effect is given by the distant correspondent placing his battery in circuit, and thereby in turn causing the bell, at the station which originally gave the signal, to ring. Both the switches are then turned to the left hand side, by which means the telephones are put in circuit and made available.

Fig. 2 shows an arrangement for a Morse and telephone

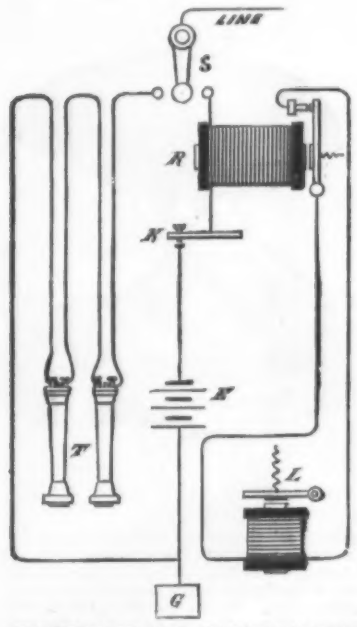


FIG. 2.—TELEPHONE AND MORSE COMBINATION.

combination, which in many cases is very convenient to have. When the switch is turned on to the right hand contact point, the Morse apparatus is in circuit, and can then be used in the ordinary way. The Morse apparatus answers also for a call to attract the attention of a correspondent when wanted; the local battery has been omitted in the diagram. When the switch is turned to the left the telephones alone are in the circuit.

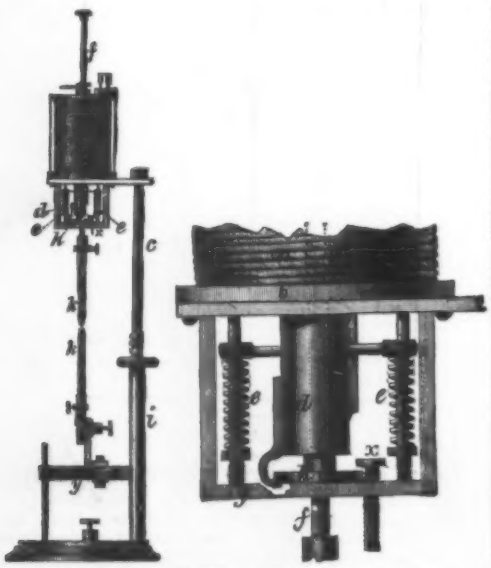
ELECTRIC LAMPS.

THE principal electric lamps now in use are described and illustrated in this article.*

The Brush Electric Lamp.—This lamp is shown in Figs. 1 and 2, in which *a* is a helix of insulated copper wire, resting upon an insulated plate, *b*, supported by the metallic post, *c*. Loosely fitted within the helix is the core, *d*, partly supported by adjustable springs, *e*.

The rod, *f*, passes freely through the center of the core, *d*, and has at its lower end a clamp for holding the carbon pencil. A washer, *h*, of brass, surrounds the rod, *f*, just below the core, *d*, and has one edge resting on the lifting finger attached to the latter, while the other edge is overhung by the head of an adjustable screw stop, *x*.

The metal post, *c*, is supported and guided by a tubular post, *i*, secured to the base. Attached to the lower end of the post, *c*, and passing out through the slot in the post, *i*,



FIGS. 1 AND 2.—BRUSH ELECTRIC LAMP.

is the arm, *y*, supporting an insulated holder for the lower carbon.

If now one conducting wire from the machine be connected to the base plate, and the other to the lower carbon holder, the current of electricity will pass up through the posts, *i c*, through the helix, *a*, rod, *f*, and carbons, *k k*, thus completing the circuit.

The magnetism produced in the helix will draw up the core, *d*, and it, by means of its lifting finger, will raise one edge of the washer, *h*, which, by its angular impingement against the rod, *f*, clamps and lifts it to a distance controlled by the adjustable stop, *x*, but separating the carbon points far enough to produce the light.

* For several of the cuts used in this article we are indebted to the "Speaking Telephone, Electric Light, and other Recent Electrical Novelties," by Prescott.

As the carbons burn away the increased length of the electric arc increases its resistance and weakens the magnetism of the helix, and, therefore, the coil, rod, and carbon move downward by the force of gravity, until, by the shortening of the arc, the magnetism of the helix is strengthened and the downward movement arrested. When, however, the downward movement is sufficient to bring the clutch washer, *h*, to the support, *g*, it will be released from the clamping effect of the lifting finger, and the rod, *f*, will

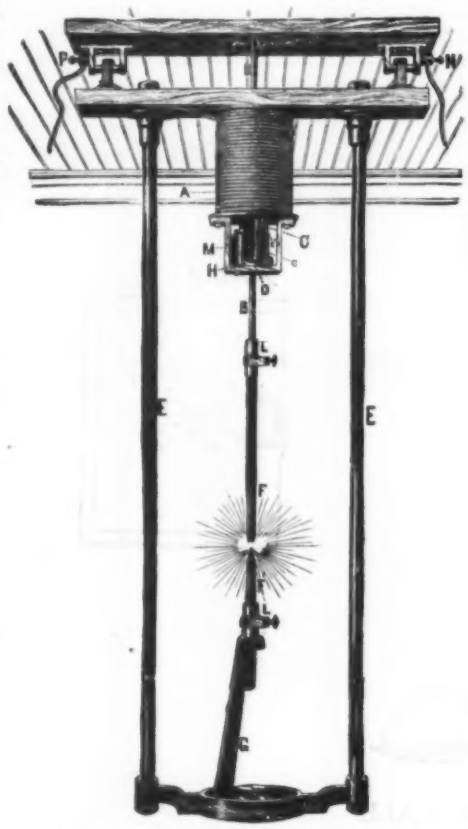


FIG. 3.—BRUSH HANGING LAMP.

slip through until arrested by the upward movement of the core due to the increased magnetism of the helix.

Fig. 3 shows this lamp arranged for factory use.

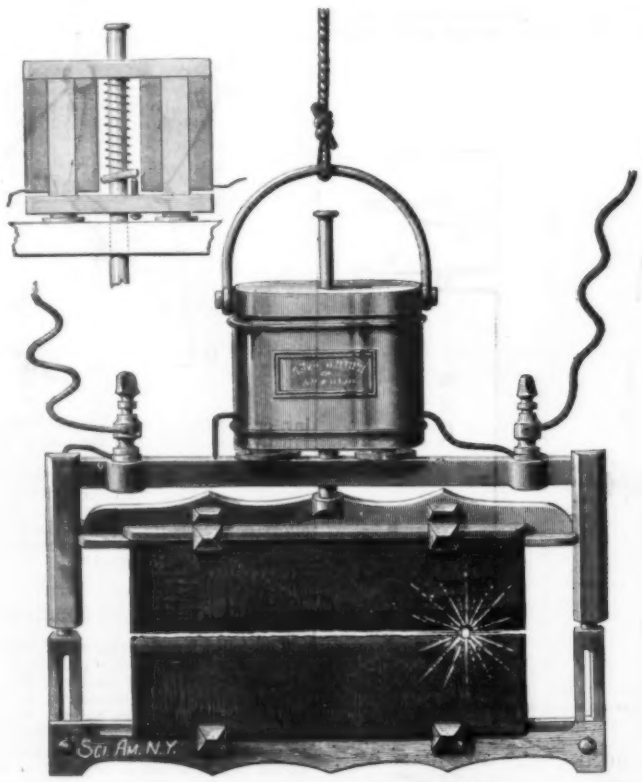
The Wallace-Farmer Lamp.—Fig. 4 is a perspective view of the lamp, and Fig. 5 is a sectional view of the magnet. This lamp consists of a metal frame of brass, fitted with terminals for the current, as shown. This frame carries the two gas carbons forming the electric wick. These carbons are in the form of short rods or slabs about 9 inches long by 3 inches broad, the upper, or positive, being about half an inch thick, and the lower, or negative, being only about a quarter of an inch thick. The lower carbon is fixed to the bottom of the frame, and the upper is carried by a crosspiece, which can slide up or down in grooves in the side of the frame. The upper carbon is, therefore, movable, and can be drawn apart from the lower one to any adjusted distance, say one eighth of an inch, so as to determine the luminous are. When the lamp is not in use, this upper carbon is let down into contact with the lower one, and rests upon it; but the act of putting on the current raises the upper carbon one eighth of an inch and establishes the light. This is effected by means of an ingenious electro-magnetic contrivance, supported above the frame and shown in Fig. 4. The vertical stem, which is fixed to the sliding crosspiece carrying the upper carbon, passes between the two bobbins of a double poled electro-magnet, shown in section. This magnet is inverted, the free poles and movable armature being uppermost. This armature, which is perforated to allow the stem to pass through it, carries a screw, which, when the armature is attracted upward by the current, tilts a small metal ring or washer, hung from a spiral spring and inclosing the stem, into an inclined position, so that it jams the stem tight and holds it fast in the manner delineated. The first act of the current, then, after it is put on, is to attract the armature until it jams the stem attached to the upper carbon, and the armature being further attracted into contact with the poles of the electro-magnet, it lifts the stem with it, and raises the upper carbon plate until its lower edge is about one-eighth of an inch above the upper edge of the lower plate. The arc then either establishes itself at the points of least resistance between the two carbons, or it may be established at any place desired, say at one corner, by inserting a metal conductor for a moment between the two carbon edges. The arc once started continues to subsist at that point until the consumption of carbon widens it to such a degree that a shorter and less resisting path for the current is to be found at a neighboring point. The current then chooses this point, and the arc is established there, until waste of the carbon causes it to shift its place as before. In this way the arc travels slowly along the whole edge of the carbons, and when it reaches the other end it turns and comes back again. For 100 hours the light can, in this way, be maintained without change of carbons and at a cost of about two cents per hour per lamp for the latter. When the current is cut off, the armature falls away from the poles of the electro-magnet, the screw releases the clamping washer, the vertical stem is freed, and the upper carbon drops down into contact with the lower carbon. When the distance between the carbons becomes at any time too great and the current is enfeebled, the armature will of itself fall away from the poles, and the carbons will close up to each other in this manner. This causes the current to regain its full strength, and the armature being again raised, the upper carbon is again withdrawn from the lower and clamped, and the light thus restored automatically.

It will be understood from our description that the upper carbon cannot be withdrawn in this manner from the lower one to a distance over one-eighth of an inch, the determined range through which the armature can move. Thus, however much the carbons may have been wasted away, at the resetting of the arc they are always withdrawn one-eighth of an inch apart.

Maxim's Lamp.—Fig. 6 represents a vertical central section of a lamp lately produced by H. S. Maxim. Fig. 7 is a perspective view of the same, and the small view beside it a detail. A is the positive carbon carrier, and B the negative.

The operation of this lamp is as follows: The negative carbon, which may be 6 inches long, being secured in the lower holder, B, the top holder may be drawn up, as the pinion that gears into its rack is free to turn in that direction without driving the train of gears. A carbon 11 inches long may now be inserted in the top holder, and its point brought in line with the lower carbon by moving the lever on the back side of the carrier.

The wires being connected to the binding post (one on each side of the lamp), the thumb nut, G, being turned will allow the weight of the positive carrier to rotate the train of gearing, and by winding up a cord to draw the negative upward until the combined movement of both causes the points of



FIGS. 4 AND 5.—THE WALLACE-PARMER LAMP.

the two carbons to meet. This will establish an electrical contact, and the current will at once commence to pass, the electro-magnet in the bottom of the lamp will become excited and draw downward the two armatures, one of which draws down one end of the cord that supports the negative carbon, and the other locks the gearing. The separation of the carbons by this downward movement of the negative establishes the voltaic arc, when the light comes out in all

its splendor. As the carbons waste away the arc becomes longer, and the resistance to the passing current becomes greater, its power to excite the electro-magnet correspondingly decreasing. The armature, E, is drawn away from the magnet by a retractile spring, the tension of which is adjusted by thumb screw, D. When the magnetism is so much reduced that the pull of the spring is greater than the pull of the magnet, the spring will force the armatures upward and remove the detent from the ratchet wheel, F, thus allowing the train of gears to move so that the carbons slowly approach each other until a point is reached where the arc is shortened sufficiently to again bring the magnet up to its original strength, when it will again pull down the armature and lock the gearing. A too rapid movement of the parts is prevented by a small fan, shown in Fig. 7. When the carbons are drawn apart to a considerable distance and then allowed to approach, this fan will revolve with great speed, and its wings will be spread by centrifugal action to their fullest extent; but when the carbons touch, and the electrical current is established, its speed is much reduced as the larger armature, C, is drawn down, and it remains in that position while the circuit is complete. The armature has an attachment which is brought within the field of the extended wings, but it cannot reach them when they are closed. The fan, when engaged by the attachment, can revolve only a quarter turn at a time and at a very slow speed.

When the ratchet, F, on the fan shaft is unlocked it can revolve rapidly only when the current is broken, and when it is released, to feed the carbons to an already established arc it can only turn at a speed a little faster than the actual consumption of the carbons. Should the arc be broken, or the light be extinguished from a high wind or other cause, the large armature, C, will be liberated, and by bringing the lower carbon against the upper carbon it re-establishes the arc instantly. A too rapid movement is prevented by a controlling chamber or dash pot in the bottom of the lamp. All of the comparatively heavy work of separating the carbons and re-establishing the current is done by the armature, C, while the smaller armature, E, has only to lock and unlock the train of gearing.

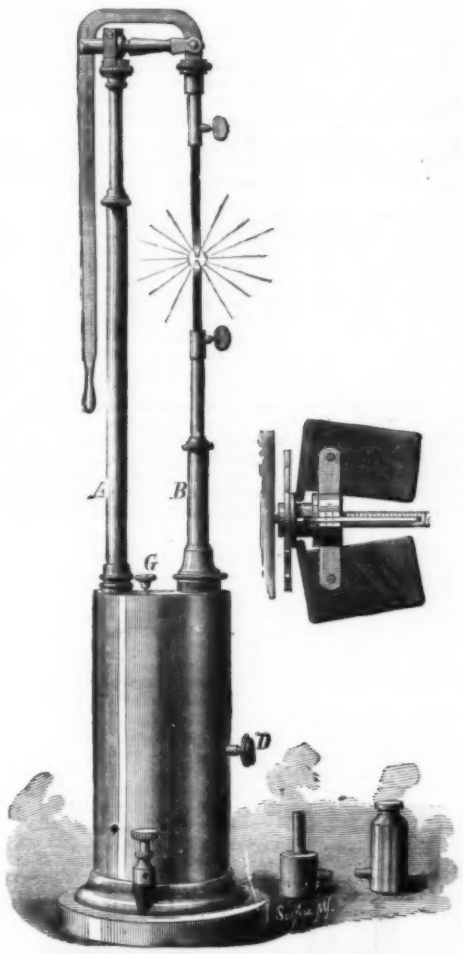


FIG. 7.—THE MAXIM LAMP.

As the distance to be traveled is very slight, and the work to be done so light, but very little change in the electro-motive force of the current is required to stop or start the feeding of the carbons. The tension of the spring that opposes the magnetism can be adjusted from the outside of the case to balance its pressure against a current of any strength. Where great nicety and steadiness are required, this lamp seems well adapted to meet all requirements. It is small and compact, and appears a very substantial and beautiful piece of mechanism.

Fig 8 is a side elevation of a less expensive kind of lamp devised by the same inventor. In this lamp both carbon holders are supported by a cord. As the upper or positive holder descends it draws the cord over a pulley and raises the negative just one half the distance traveled by the positive. When the wires are properly connected and the carbons are in position, the top holder may be allowed to run down until the two carbons meet. This establishes the circuit and excites the axial magnet in the bottom of the case, when the core is drawn into the helix, and the two carbons, through the medium of levers, are drawn apart until the magnetism and tension of the spring balance each other, and as the carbon is burned away the arc is lengthened, the magnetism reduced, when the core is drawn out of the spool, thus feeding the carbons together as they are consumed until the parts have reached a position where the ratchet on the lower level is beyond the reach of the pawl, then the core descends and the ratchet revolves, when the carbons take a new position, and the feeding goes on as before. The ratchet wheel is prevented from turning more than one tooth at a time by a spring at the end of the lower lever. The pull of the rack is opposed to the spring, and when the pull is reduced by the disengagement of a ratchet tooth the lever, and with it the ratchet, are forced downward, and the succeeding tooth is caught on the pawl. The core on which

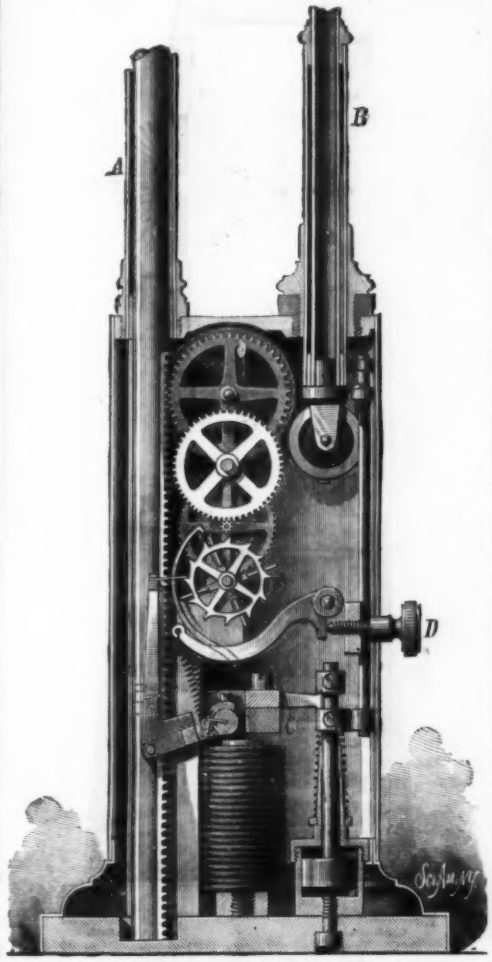


FIG. 6.—REGULATING APPARATUS OF THE MAXIM LAMP.

the magnetism operates is connected with the rack by compound levers, so that by changing the position of the connecting link the leverage can be readily adjusted.

Adjustments may also be made with the thumb nut on the top of the case, which is attached to a retractile spring. While this lamp is not so susceptible of a very fine adjustment, still for some purposes it is better than the more

FIG. 8.—MAXIM LAMP WITHOUT GEARING.

expensive one just described. In places where the speed of the dynamo-machine varies much, or where the machine is of poor quality, it is better than the regular clockwork lamp.

The Jablochkoff Candle.—This invention consists in placing two carbon pencils side by side and insulating them from each other by means of a thin plate of some refractory substance inserted between them, which is a non-conductor at ordinary temperatures, and becomes a conductor when fused by the action of a powerful current. The most suitable material yet discovered is plaster of Paris, which is used in all of the candles now in operation.

Each lantern consists of four candles, which are brought into operation successively, only one candle being burned at a time. This is necessary in order to keep up the light for the required length of time each night, a single candle as now made lasting only one and one half hours. Fig. 9 shows the devices for holding the candles. These are mounted upon a circular base of white onyx, A, which supports and insulates the parts. Four candles are arranged in the

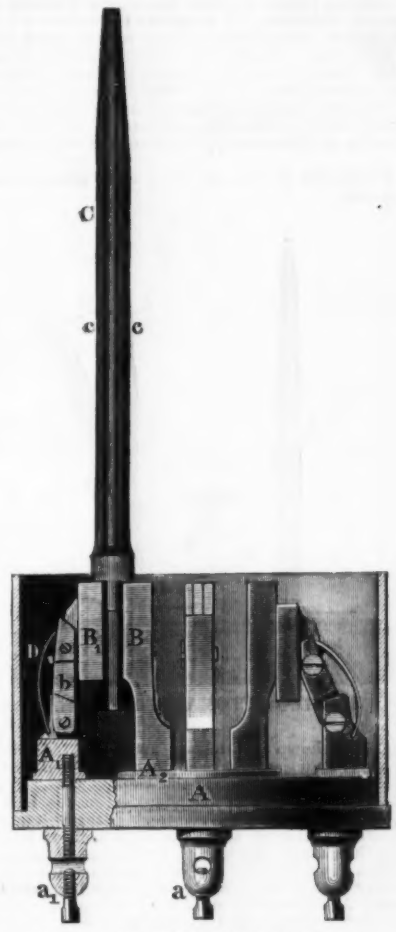


FIG. 9.—JABLOCHKOFF CANDLE.

form of a cross, and surrounded by a 16-in. globe of white opal glass.

The two cylindrical pencils, *c c*, of compressed carbon are each 8·8 inches in length and 0·157 inch diameter.

The candle holder or clip consists of two jaws, B B¹, one of which, B, is fixed, and the other, B¹, movable. The opposite faces of these jaws have vertical semicircular grooves for grasping the candle. The four fixed jaws, B, in each lantern are mounted upon a common metallic base plate, A², to which the positive pole of the circuit is connected by means of a binding screw, *a*. Each movable jaw, B¹, is jointed by means of a link, *b*, to a block, A¹, which is provided with a binding screw, *a*¹, to which the negative conductor is attached. A spring, D, presses the movable jaw against the candle. A small metallic plate is attached to the lower end of each carbon pencil on opposite sides of the candle to insure a good connection with the holders. Each

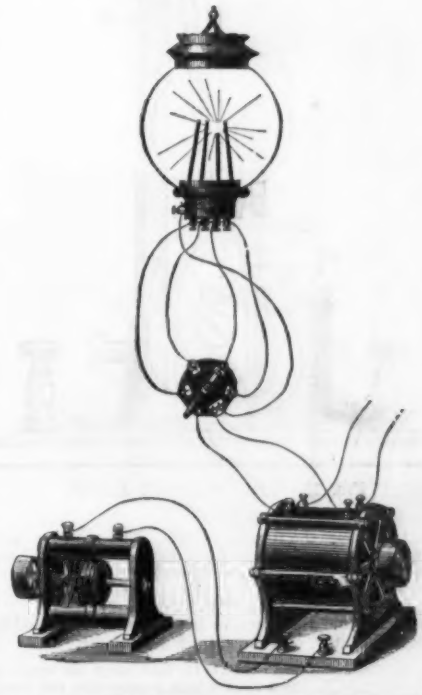


FIG. 10.—ARRANGEMENT OF JABLOCHKOFF LIGHT APPARATUS

candle is provided with a conducting tip, consisting of a piece of powdered plumbago and gum compressed into little cylinders about as large as No. 18 wire and attached to the candle by a strip of asbestos. This completes the circuit

when the machine starts, and maintains it until the fusion of the plaster of Paris commences.

Four distinct currents may be derived from an alternating magneto machine. Each of these currents is capable of supplying four candles at a time when placed in series in the circuit, for the reason that at the high temperature produced by the current, plaster of Paris becomes a tolerably good conductor of electricity. A conductor leads from the positive terminal of the machine to an ordinary lever switch placed in the base of the lamp post. This switch turns on five points, four of which are connected respectively with the four movable jaws, B^1, while the fifth connects with the return wire leading from the central binding screw, *a*. This switch thus serves to direct the current to any one of the four candles, or, if necessary, to cut out the whole arrangement.

Fig. 10 will give an idea of the general arrangement of the apparatus.

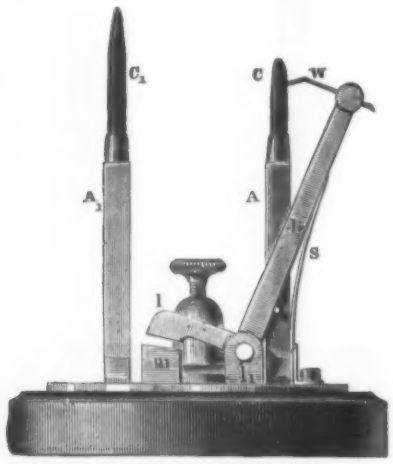


FIG. 11.—AUTOMATIC SWITCH.

In Fig. 11 is shown an automatic apparatus for switching the current from one candle to another. A A^1 are two candle holders in which are placed the candles, C C^1. An upright lever, L, is pivoted to a standard, l^1, on the base. A spring, S, presses against this and tends to throw it into such a position as to bring the short arm, *l*, of the lever into contact with the metallic block, *m*, but this movement is prevented by a platinum wire, *w*, which is attached to the top of the lever, L, and rests against the insulating portion of the candle, C, at a point near its socket. When the candle, C, is burned down far enough to release the wire, *w*, the spring, S, throws the lever, L, over, making contact between *l* and *m*, and thus bringing the candle, C^1, into the circuit.

The Weston Lamp.—Fig. 12 represents the Weston electric lamp or torch. It consists of two carbon pencils, B E, supported in sockets attached to a suitable base. The socket, *b*, of the negative carbon is fixed; that of the positive carbon is movable, and has attached to it an armature, *c*, which extends over the electro-magnet, C. The positive carbon, E, is pressed toward the negative carbon by a spring, and it is drawn away by the action of the magnet on the armature, *c*, as the current increases in strength. When the

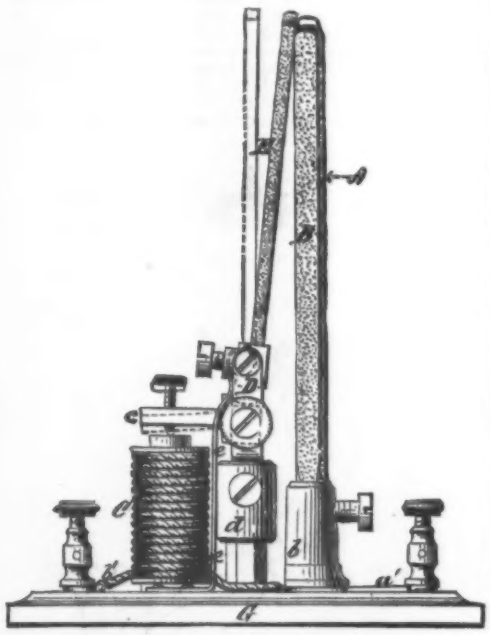


FIG. 12.—THE WESTON LAMP.

current weakens, the reverse occurs. The negative carbon has twice the area of the positive, to insure the equal burning of the two pencils, and it has a longitudinal groove, in which is cemented a stick of lime, glass, or other material that may be vaporized at a high temperature.

The light from this torch or lamp somewhat resembles a gas light, but it is, of course, far more intense.

The Serrin Lamp.—Fig. 13.—In this lamp the upper carbon holder, A B, has a rack which works into the toothed wheel, F; it tends to descend by its own weight and to make the carbon, C, descend and also to turn the toothed wheel. On the axis of the latter is fixed a pulley, G, which, by means of a chain and pulley, J, communicates an ascending motion to the rod, K K, which carries the lower carbon. This motion takes place so long as no current passes, and thus draws the carbons into contact. When the circuit is closed, and the current is introduced into the apparatus, the electro-magnet, E, attracts a soft iron cylinder, A; this latter forms a part of an oscillating parallelogram, T, A, S, R, which de-

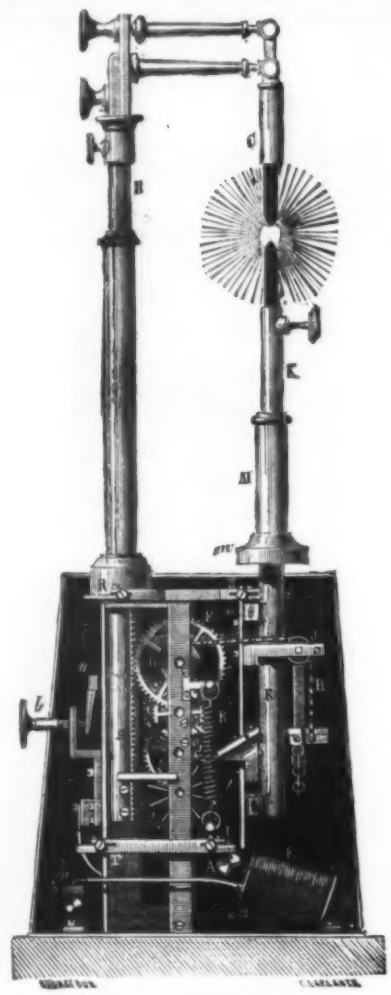


FIG. 13.—SERRIN LAMP.

scends with the armature and draws with it the carbon carrying tube, K K, to which it is attached. A triangular shaped

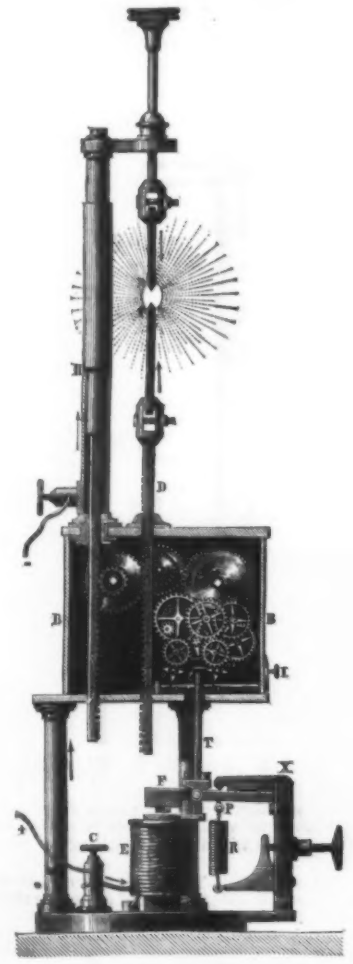


FIG. 14.—FOUCAULT LAMP.

piece, *d*, of the oscillating system comes against one of the tongues of the catch wheel, *e e*, which causes a stoppage of the wheels. The two carbons then separate, and the voltaic arc is formed.

As the carbons consume the current diminishes, the magnet weakens, and the armature, A, yields to the action of the antagonistic spring, R. The oscillating system then rises, draws up the catch, *d*, so that the catch wheel is disengaged and the wheels work again. The carbons approach each other, increasing the intensity of the current, when the armature is attracted, and so on indefinitely.

Foucault's Lamp.—Fig. 14 shows a form of lamp devised by Foucault. In this there are two systems of wheelwork, one for bringing the carbons together, the other for separating them, and it is principally in the addition of this last arrangement that the lamp differs from that of Duboscq.

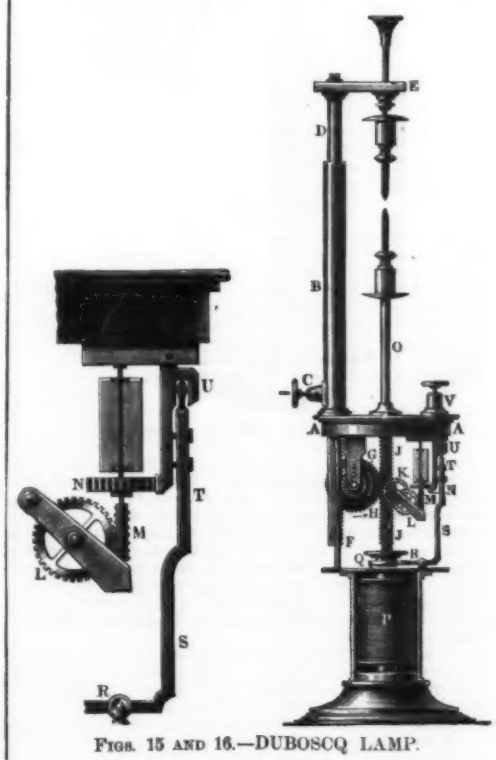
L' is a barrel driven by a spring inclosed within it, and driving several intermediate wheels which transmit motion to the fly, *o*. L is a second barrel driven by a stronger spring, and driving in like manner the fly, *o'*. The racks which carry the carbons work with toothed wheels attached to the barrel, L', the wheel for the positive carbon having double the diameter of the other. The current enters at the binding screw, C, on the base of the apparatus, traverses the coil of the electro-magnet, E, and passes through the wheelwork to the rack, D, which carries the positive carbon. From the positive carbon it passes through the voltaic arc to the negative carbon, thence through the support, H, to the binding screw connected with the negative pole of the battery. When the armature, F, descends toward the magnet, the other arm of the lever, F P, is raised, and this movement is resisted by the spiral spring, R, which, however, is not attached to the lever in question, but to the end of another lever pressing on its upper side and movable about the point, X. The lower side of this lever is curved, so that its point of contact with the first lever changes, giving the spring greater or less leverage, according to the strength of the current.

In virtue of this arrangement, which is due to Robert Houdin, the armature, instead of being placed in one or the other of two positions, as in the ordinary forms of apparatus, has a position accurately regulated according to the strength of the current.

The anchor, T *t*, is rigidly connected with the lever, F, P, and follows its oscillations. If the current becomes too weak, the head, *t*, moves to the right, stops the fly, *o'*, and releases *o*, which, accordingly, revolves, and the carbons are moved forward. If the current becomes too strong, *o* is stopped and *o'* is released, and the carbons are drawn back. When the anchor, T *t*, is exactly vertical, both flies are arrested, and the carbons remain stationary.

Duboscq's Lamp.—Figs. 15 and 16 show a form of lamp devised by Duboscq, and operated by the combined action of the current and a system of wheelwork driven by a spring.

On a circular brass plate, A, is mounted a metallic tube, B, to which is attached the binding post, C. A metallic rod, D, sliding in this tube, carries at its top the arm, E, to which is also attached a rod and socket for holding the upper carbon. This rod is arranged to slide in the arm, E. The lower end of the rod, D, is provided with a rack, F, which engages the wheel, G, which is on the same shaft with the wheel, H, and is held in place by friction. Within a barrel connected with the wheel, H, there is a powerful spring which actuates the mechanism of the lamp. A double rack, J, terminating above in the rod, O, which passes through an insulating guide in the cover, and is provided with a socket for holding the lower carbon, engages one side of the wheel, H, and on the other, with a pinion on the axis of the wheel, K. This wheel engages with the pinion of the wheel, L,—better shown in Fig. 15—and the latter engages an endless screw, M, on the prolongation of the axis carrying the cog wheel, N, and fly, X. An electro-magnet, P, consist-



FIGS. 15 AND 16.—DUBOSCQ LAMP.

ing of a hollow iron cylinder, with its helix of insulated copper wire, is placed in the base of the lamp, and one end of the wire of the helix is connected with the binding post, V, which is insulated from the cover. The other end of the wire is connected with the lower end of the rack, J, which moves up and down in the hollow of the core. A circular piece of iron, Q, attached to the bent lever, R S T, serves as an armature to the magnet, and when attracted by the latter, the pallet of the supplementary lever, U, which is controlled by the long lever, R S T, to catch the wheel, N, and thus arrest its motion and that of the train of wheels.

When the lamp is to be used, the rod, D, is raised. This causes the wheels, G and H, to revolve, and thus lower the rod, O, so that the carbons can be inserted. If allowed to act, the carbons will approach and touch each other. The battery can then be connected; the positive pole to the post, V, the negative to C. The carbons are now separated so as to form the arc. They are afterward allowed to approach only as the current becomes weakened, and the armature of the lever, R S T, is allowed to retreat, and thus release the wheel, N, when the current becoming stronger, the armature is again attracted, and the wheel, N, is stopped. The train is thus stopped and started according to the changes in the current.

Archereau's Regulator—The Archereau regulator, represented in Fig. 17, is the most simple of all. It consists of a hollow copper bobbin, coiled with insulated wire, a vertical standard, two carbon carriers, and a counterweight. The upper carbon is carried by a bar which slides into and turns at the extremity of a horizontal copper bar, insulated and in communication with the negative conductor of the electric current. The lower carbon rests on a cylinder, half of copper half of iron, which can rise or fall in the hollow bobbin. The positive conductor is attached to one of the extremities of the wire on the bobbin, and the other extremity of this wire is fixed to the interior cylinder of the bobbin. The lower carbon is in direct communication with the positive pole, because the cylinder which carries it touches at several points the cylinder of the bobbin. A counterpoise equilibrates the lower carbon carrier in such a manner that its movement, in either upward or downward direction, may be effected with insignificant effort. (To disturb equilibrium, it is sufficient to overcome the friction of the cylinder against the interior sides of the bobbin.)

The upper part of the cylinder is of iron, the lower part

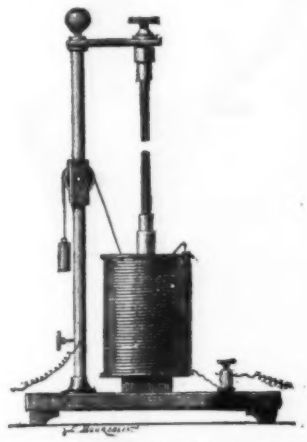


FIG. 17.—ARCHEREAU'S REGULATOR.

of copper. When the current passes in the exterior wire, it produces a magnetic action which causes the cylinder to descend in the bobbin, and as the current is thus interrupted, the action of the counterweight raises the cylinder.

To put the apparatus in action it suffices to bring the upper carbon into contact with the other, and then to slightly separate them; the voltaic arc is formed, the cylinder remains fixed in the bobbin, and the counterweight is motionless. This arrangement is maintained while the distance of the carbons is not too great; but the voltaic arc soon surpasses a given length, and the current is too feeble to cause the cylinder to resist the action of the counterweight. At this instant the lower carbon rises, when the current again attains sufficient power, and stops the cylinder until fresh consumption leads to another movement of the lower carbon. It is a simple question of balance, to be realized by proper proportion of the several parts and by the exact determination of their relative positions.

The Rapieff Electric Light.—The chief novelty of the system consists in the use of four carbons, instead of the two which, in nearly every other arrangement, form the points between which the luminous arc is produced. These carbon rods, instead of being placed parallel with one another, are so inclined that their points meet. Or to put the matter more clearly, the two upper carbons form the letter V, while the two others, forming the same letter upside down Λ, are placed so that the combination represents an X. But the lower pair are set at a right angle to the upper. In plan, therefore, the four rods would form a cross.

One great advantage in M. Rapieff's system is that a nearly burnt-out carbon may be replaced by a fresh one without any stoppage of the light. This operation, too, can be performed without the intervention of a skilled worker. In Fig. 18 the attendant—protected from the glare of the naked light by a small screen of colored glass—is in the act of replacing one of the negative carbons. The right hand lamp is shown as commonly used, with the light softened by a globe. The screw, S, in both lamps, is the means whereby the distance between the two pairs of carbons is regulated and kept constant. Indeed, we understand that the size of the arc can be so adapted to the current supplied, that a lamp can be made to represent the value of 100 gas flames, or of merely 10.

The carbons, as they consume away, are made slowly to approach each other, so that the arc is always of the same width, and keeps its fixed position in the space. To this effect the carbons are directed together over small pulleys at *d* (Fig. 19). The directing force is supplied by a lead weight or counterpoise, *w*, of about three pounds, which slides down the brass stems, *s s'*. The weight is supported by two silk or asbestos cords from the outer ends of the carbon sticks. In this way the descent of the weight draws the four carbons equally together as they are wasted away. A curved reflector of silvered brass or porcelain is fixed a little above the inner ends of the upper carbons. By means of the screws, *f* and *e*, the width of the arc is adjusted, and by similar screws the angle at which the lower points face the upper ones can be varied, so as to direct the arc to one side or the other. The wooden base, B, carries four terminals for connecting the wire conveying the current. The base is hollow, and contains an electro-magnetic apparatus for starting the light. At first the carbon points are in contact, but when the current is put on, it passes through a dual electro-magnet in the base, the armature of which is attracted upward and pushes a rod up the hollow stem, *s'*. This rod allows the lower carbon to drop away from the upper to the

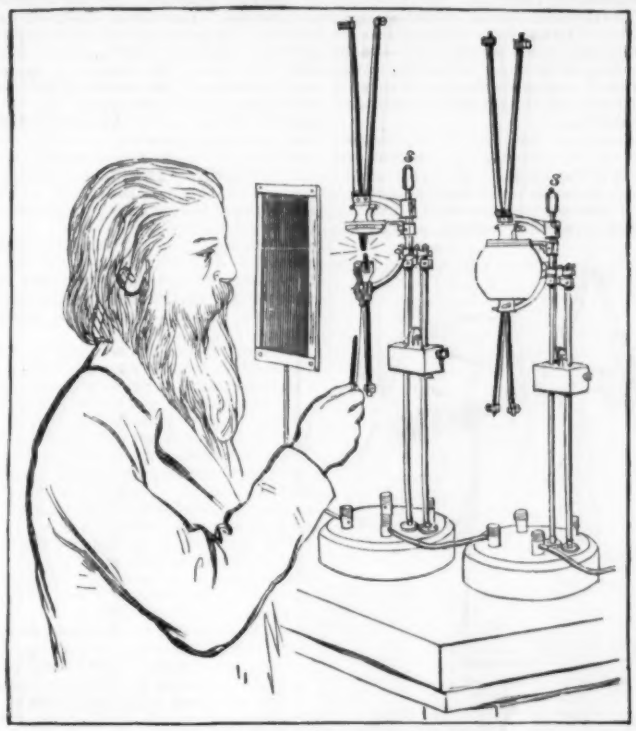


FIG. 18.—RAPIEFF ELECTRIC LIGHT.

full width of the arc as previously adjusted. The positive and negative currents pass to their respective upper and lower carbons by means of the stem, *s s'*, and the curved brackets. With carbons 20 inches long and 5 millimeters in diameter, the light is maintained for seven or eight hours, and with those 6 millimeters thick it is kept up for nine or ten hours. The light is equivalent to from 100 to 120 gas flames, or say about 1,000 candles. The smallest form of the

FIG. 19.—RAPIEFF ELECTRIC LAMP.

lamp made gives a light estimated at five gas flames. The resistance of the arc is only two or three ohms.

Fig. 20 represents a modified form of Rapieff's lamp. In it the carbons are simply inclined to each other at an angle which can be regulated by screws, *d d'*. The width of the arc can also be regulated by the same screws. The carbons are drawn together by the descent of a counterpoise, *w*, in a similar manner to that above described. In the lamp the planes of the carbon pairs are parallel to each other. A cylinder of lime, *c*, is supported over the arc, and becoming luminous increases the illuminating power of the arc by about 40 per cent. The carbons M. Rapieff employs are

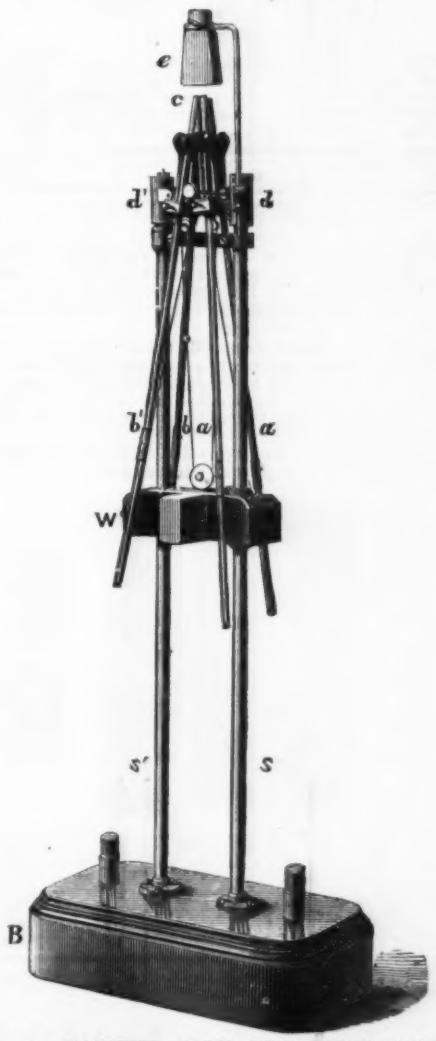


FIG. 20.—MODIFIED FORM OF RAPIEFF LAMP.

made by M. Carré. The light is very pure and white, and can be considerably varied in intensity by the adjusting screws. There are six lamps in each circuit in the London *Times* office, but M. Rapieff has successfully exhibited as many as ten.

The Regnier Electric Light.—The following engraving, Fig. 21, represents a new form of the Regnier electric light, which operates continuously for 24 hours. The essential feature of the apparatus is the circular carbon plates used instead of points, the voltaic arc passing between the edges of the rotary disks.

The device will be easily understood by the following reference to the illustration. *a* is the base, *b b' b' b'* forked standards, *d d'* carbon disks or rheophores having a continu-

ous rotary motion imparted to them by the clockwork motors, f and f'. At $g g'$ are the trunnions on which both disks and motors oscillate; $i\,h$ is a forked lever connected to the motor, f, by a long curved rod; k is a button screwed on the end of this lever, and ending in the cup, l. By means of this screw the motor, f, is caused to move backward or forward in order to adjust the carbons. m is a solenoid commanding a soft iron magnet (not shown).

Through the rod, p, crank, r, and arm, s, this magnet pulling downward moves the motor, f', to the rear and determines the separation of rheophore, d. At $t\,t$ are springs moving the rheophore, d', in contact with the rheophore, d, to establish the light. These springs attached at u and at v, act on the motor, f, through crank, r, and arm, s. $x\,y\,x$ is a

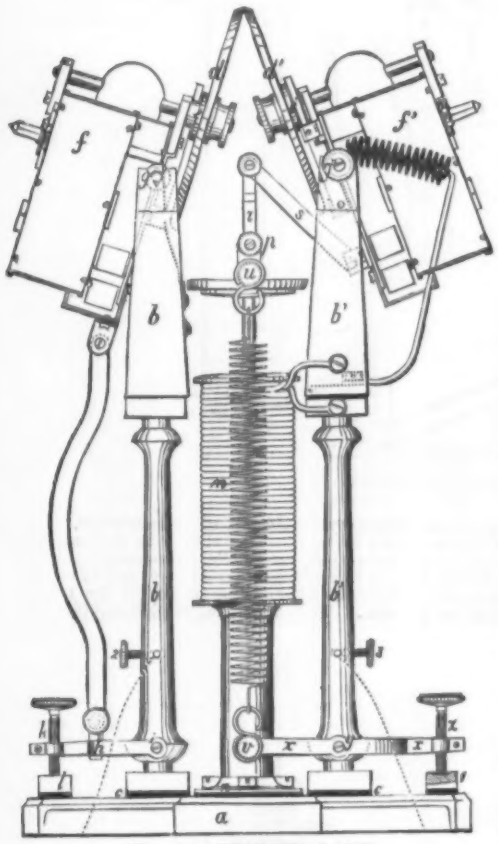


FIG. 21.—REGNIER LAMP.

forked lever attached at one end to the springs and carrying at its other extremity a set screw by means of which the springs are more or less extended and the lamp regulated. At 2 and 3 are the binding screws for the battery wires.

Reynier's New Electric Lamp.—In the new system here described, the renewal of the carbon is progressive. The pencil, incandescent at one part of its length, proceeds almost continuously, until every portion that can be utilized is completely used up. This system will operate in free air. This is the principle involved.

A cylindrical or prismatic pencil of carbon, C (Fig. 22), is traversed between i and j by an electric current (continuous or alternate) sufficiently intense to render it incandescent in this portion. The current enters or passes out through the contact, l; it passes out or enters through the contact, B. The contact, l (which is elastic), presses against the carbon laterally; the contact, B, touches it at the extremity. Under these conditions, the carbon wears away at its extremity faster than at any other point, and tends to shorten. Consequently if the carbon, C, is urged forward continuously in the direction of the arrow, it will advance gradually, in proportion as it wastes away, sliding through the lateral contact, l, in such a way as to continually touch the terminal contact, B. The heat developed by the passage of the current through the pencil is greatly increased by the combustion of the carbon.

In practice, the fixed contact is replaced by a revolving contact, B (Fig. 23), which carries off the ashes of the carbon. The rotation of the terminal contact is made to depend on the progressive movement of the carbon; so that the latter acts as a check on the motive mechanism of the lamp.

The principle of this new system of lamps having been established, it became an easy matter, of course, to devise a simple apparatus to put it into execution.

A mere inspection of the model (Fig. 24), which was exhibited by the inventor, M. Emile Reynier, before the Société de Physique, will serve to show how it operates. The progression of the carbon, C (Fig. 24), and the rotation of the terminal contact, B, are obtained by the descent of the heavy rod, P. To wind up the lamp it is only necessary to raise this column. The carbon pencil is put in place without any adjustment.

The luminous point remains fixed in one place, a very important matter, and especially so in optical experiments. This apparatus gives a clear white light with four Bunsen elements. With more powerful electric sources, several lamps may be illuminated by this system, and thus a subdivision of the electric light may be obtained. With a battery of 36 elements the inventor has operated four lamps, in tension, on a single circuit; these he extinguished and relighted at pleasure, several times; each of the four lamps he extinguished and relighted separately, the other three continuing to shine. Light has been obtained in one of these lamps by the current from a small laboratory Gramme machine. Finally, a beautiful light has been obtained with a Planté battery of 3 elements (secondary). These experiments may be considered as a step toward the application of the electric light to domestic uses.

Fig. 25 shows a newer mechanical arrangement of one of these lamps, which has not been hitherto published. In this device the rotation of the revolving contact is obtained by the pressure of the carbon on the circumference of the disk. By this means the end of the incandescent pencil never leaves the revolving contact, thus avoiding any cause for inequality in the light. The check, which is indispensable, is obtained as follows:

The wheel, B, is borne at the extremity of a lever which articulates at O. The pressure exercised by the carbon on the wheel, B, causes the shoe, S, to rub on the felly of a smooth wheel, A, which is turned by the descent of the heavy rod, P, through the medium of its rack and pinion, a. According as the point of the luminous conductor presses more or less on the wheel, B, the check prevents to a greater or less degree the descent of the column, P, the advance of which is imperceptible.

The Werdermann Electric Light.—The principle of Mr. Werdermann's invention consists in keeping a small vertical pencil of carbon in contact with a large horizontal disk of the same material above it. Mr. Werdermann was led to adopt this arrangement as the result of numerous experiments.

He places the negative electrode uppermost, giving it the form of a solid disk of carbon, about two inches in diameter and one inch thick. This is encircled by a band of copper ribbon and prolonged to a terminal to which one of the machine wires is attached. The lower or positive carbon, which is a thin round pencil, 3 millimeters in diameter, is placed vertically beneath the negative electrode, in a tube up which it slides. This tube has a prolongation of thick copper divided in two parts, and, pressing against the pencil and forming contact with it, this forms the other terminal of the lamp.

The lower carbon is kept in contact with the upper one by chains attached to its lower extremity, coming up over pulleys and down again to a counterbalance weight, which always keeps the point of the pencil in gentle contact with the disk as the former gradually burns away.

By referring to Fig. 26, the general idea of the lamp will be seen at a glance.

a is the negative carbon, b is the pencil sliding in the tube, c, and gripped at the top of the tube by the split contact piece, the pressure of which is regulated by the spring, d. The conductors, e, form part of the lamp post, having terminals at the bottom, and one is connected to the tube, the other, by means of the semicircular piece of metal, f, to the upper carbon; f is hinged for the purpose of moving away the negative disk when a globe is to be put on the lamp.

The tube is shown in perspective for the sake of greater clearness.

The experiments were commenced by putting two tall lamps in circuit such as will be used for outdoor lighting.

These lamps gave a light estimated at 360 candles each,

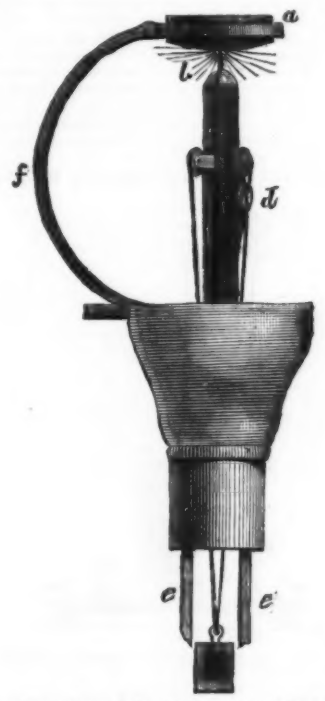


FIG. 26.—THE WERDERMANN ELECTRIC LIGHT.

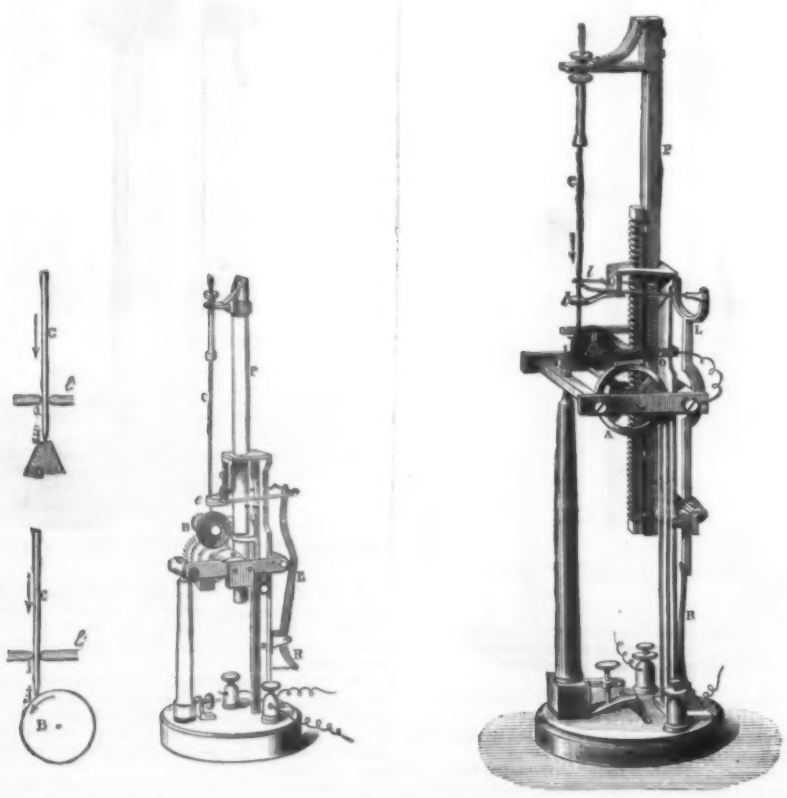
and were connected together in parallel circuit. The lamps had no globes, and the lights were wonderfully clear, of a pure color, and perfectly free from the blue or purple rays so often seen in the electric arc. Better than all was the remarkable steadiness of burning, there being an entire absence of any jumping or flickering whatever.

After allowing these to burn for some time, the current was then sent through a row of 10 smaller lamps, arranged on a shelf, and connected parallel. These lamps were estimated to give about 40 candles each; each one burned with the same brilliancy and steadiness, and proved most conclusively that the divisibility of the light was an accomplished fact, and when we say that this satisfactory result was obtained with an electro-plating Gramme, the bobbins of which are wound with thick copper ribbon, and giving an electro-motive force of only 4 Daniell's cells, it seems probable and reasonable to suppose that with suitable machines, Mr. Werdermann will be enabled to put 50, 100, or even 500 lights in circuit, and thus solve the problem of dividing the light more completely than has hitherto been the case.

The Sawyer-Man Electric Lamp.—The general appearance of the lamp is shown in Fig. 27. The light is produced by the incandescence of the slender pencil of carbon placed as shown in the engraving. The light-giving apparatus is separated from the lower part of the lamp by three diaphragms, to shut off downward heat radiation. The copper standards lower down are so shaped as to have great radiating surface, so that the conduction of heat downward to the mechanism of the base is wholly prevented. No detailed description of this portion will be required, further than to say that the electric current enters from below, follows the line of metallic conduction to the "burner," as shown by the arrows, thence downward, on the other side, connecting with the return circuit. The light-producing portion is, of course, completely insulated, and also sealed at the base, gas tight.

A fatal defect in all previous lamps depending on incandescent carbon has arisen from what has been called the "vaporizing" of the carbon. This Mr. Sawyer holds to be an absurdity, since the carbon is not even fused. The wastage of the carbon in mercurial vacuums, and in atmospheres of compound gas, is due, he holds, to chemical decomposition. Many gases, indifferent to carbon at ordinary temperatures, attack it destructively at temperatures obtained in the electric lamp; and the process is continuous, the carbon taken from the burner being redeposited on the glass case, and the gas left free to continue its depredation. Mr. Sawyer claims to have overcome this difficulty by his method of charging the lamps with pure nitrogen, and by providing for the fixing of any residual oxygen left in the lamp. In this way an unwasting carbon is secured.

Fahrig's Burner for Electric Light—The engraving, Fig. 28, shows a sketch of a new burner for the electric light. It consists of a glass tube, one-half inch inside and about ten inches long, which is bent to the shape shown, both arms as close as possible together. A small hole is drilled in the top of the bent tube to insert two pieces of wire, No. 30 platinum. Length of platinum wire one inch and three-quarters inside each arm of the tube. Two carbon pencils, well fitted to the tube and one inch and a half long, con-



FIGS. 22, 23, 24, AND 25.—REYNIER ELECTRIC LAMP.

nected on the flat end to a copper wire of No. 12 thickness, are now inserted into the tubes, the points toward the platinum wires, leaving one quarter inch space between the carbon points and the ends of wires. The tube is now warmed, and the air expelled, and quickly sealed and cemented with any fire resisting cement. The two platinum wires are one pole, the two carbon wires the other pole, to be attached to the battery or magneto-machine power. The light so obtained is very brilliant, steady, and clear, having many advantages over the two-point carbon burner, and dispenses with the costly regulator. How far the success of the new burner can be estimated is not known, and must be proved by longer experiments; but as at present it is worthy of adoption and improving in this direction. A bell shaped globe is better than a round one.

A Simple Electric Light.—Below (Fig. 29) is a description of a very simple and tolerably economical method of lighting rooms by electricity:

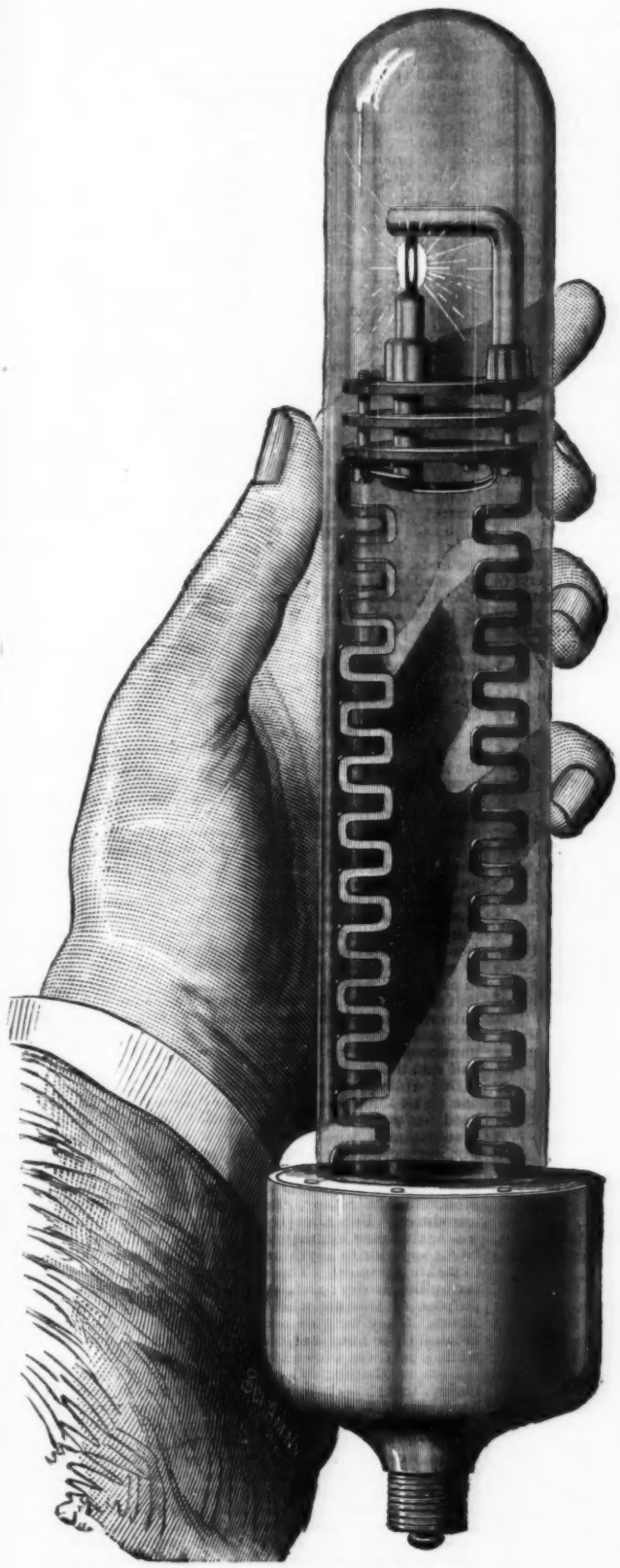


FIG. 27.—THE SAWYER-MAN LAMP.

B is a bell glass resting in a vulcanite tray, V, attached to a wooden stand, S; the two wires, W, pass air-tight through bottom of tray and stand to the two poles of an ordinary three or four cell bichromate battery; C is a very slender pencil of gas carbon connecting the two ends of the wires; P is a metal cup to hold a bit of phosphorus. Having made the lamp as sketch, proceed as follows: Nearly fill the tray, V, with water, light the phosphorus in P, and put the glass cover, B, in its place; do this a few hours before the lamp is wanted for use. The phosphorus unites with the oxygen in the bell glass and becomes converted into phosphoric acid, which is gradually absorbed by the water, and nothing remains but pure nitrogen in the lamp. Connect the ends of the wires to the two poles of the battery, and the carbon pencil, C, will glow with a brilliant white light, and remain in that state unconsumed, owing to the absence of oxygen gas.

Of course any form of battery may be used, I prefer the bichromate in a trough form, and mounted on rockers, and the whole placed on the floor under the table, so that an occasional touch of the foot will give a rocking motion to the battery, and so cause a circulation of the liquid, and in that way keeping up the action of the battery until all the solution is exhausted.

Any of your readers trying this method will find success certain, and expense trifling in proportion to the brilliancy of the light.—*W., in English Mechanic.*

Light by Incandescence of Metallic Conductors.—The metal most advantageous for the purpose is that which, while it requires very high temperature for its fusion, has but a feeble affinity for oxygen, and offers a great resistance to the passage of an electric current. Platinum, though not so infusible as iridium, has but little affinity for oxygen, and offers a great resistance to the passage of the current, and as it is abundant and easily worked into the required form, it is deemed preferable to any other metal. The platinum should be worked into those exceedingly thin sheets known by the name of leaf platinum. This may be accomplished by the ordinary process of the goldbeater; but a more accurate method is to place a piece of platinum foil between two thick plates of rolled copper, and reduce the whole to a thin sheet by rolling, when, on separating the copper pieces, the platinum leaf will be found of uniform thickness in every part. In this way it may be obtained so thin that on holding it before a printed page the letters can be distinguished through it. A strip is to be cut from one of these sheets of a width proportionate to the quantity of the current, which, with Daniell's cells, 20 inches high and 3 inches in diameter, is about one quarter of an inch, and of a length proportionate to the intensity, which of course varies with the number of cells. Great care must be taken to cut the platinum strips of an equal width throughout, and with a clean edge, as, if this is not carefully attended to, the strip will be unequally heated, and will be fused in one part before the other parts have obtained a sufficiently high temperature to produce a brilliant light. The platinum strip is now to be suspended between two forceps in an instrument made for the purpose, one form of which is shown in section in the engraving annexed, Figure 30. A is a square brass bar fixed into the wooden stand, C, having a binding screw, F, attached to its lower end. The two arms, E D, are attached to sockets which slide on this bar, so as to admit of their being placed at different distances from each other. They are both bent at right angles, as seen in the figure, and terminated by broad forceps tipped with platinum. These forceps are closed by the milled screws, H I; the arm, C, has a rod, N, with a screw cut on it passing through it, and by means of the two nuts, B B, working on this rod the arm may be adjusted to any required height, and the distance between the forceps thus regulated. The rod passes through the stand, and is attached to the binding screw, G. The socket, K, is lined with ivory, or some other non-conducting substance, so as to prevent any metallic communication between the arm, E, and the bar; S is the strip of platinum leaf which is first clamped in the upper forceps; the arm, E, is now adjusted to any required height, and the lower forceps are closed so as to clamp the lower end of the strip of platinum. It may now be included in the battery circuit by attaching one of the wires to the binding screw at F, and the other to that at G. The current should be one of considerable intensity, and the distance between the forceps should be sufficient to prevent the platinum being fused. The distance may be lessened by raising the arm, E, and shortening the strip of platinum, until it attains the highest temperature it will bear without fusing; or the same object may be attained by increasing the intensity of the current. The glass shade, R, which serves to screen the platinum from currents of air, dust, etc., may then be passed over the apparatus, as seen in Fig. 30.

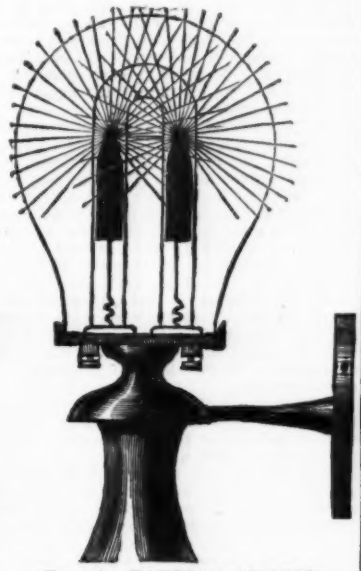


FIG. 28.—FAHRIG'S BURNER.

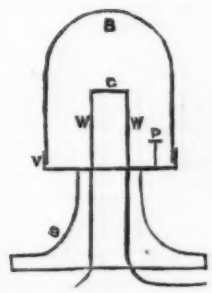


FIG. 29.—A SIMPLE ELECTRIC LIGHT.

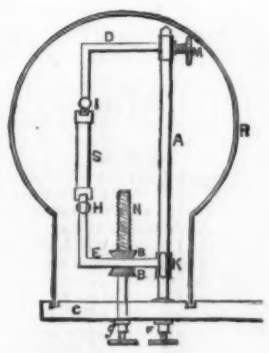
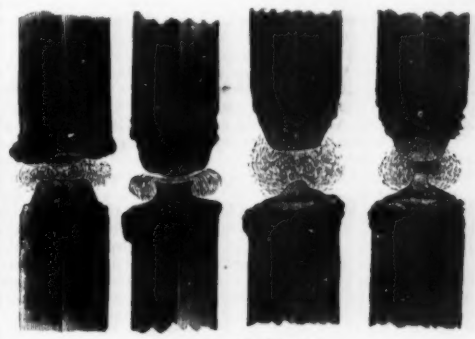


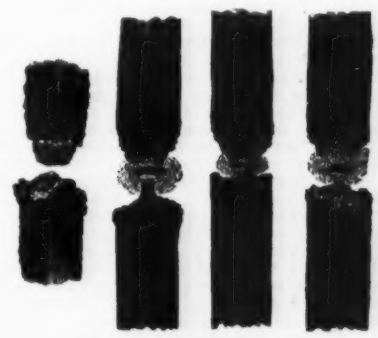
FIG. 30.—PLATINUM LAMP.



FIGS. 31, 32, 33, 34.

Figures 31 to 38, inclusive, represent the carbon pencils under conditions varied by position and strength of current.

Edison's Electric Light.—Up to the present date Mr. Edison has maintained rigid secrecy in regard to his method of illuminating by electricity.



FIGS. 35, 36, 37, 38.

The substance of what is known is contained in an editorial in a recent number of the SCIENTIFIC AMERICAN, from which the following is extracted:

"But what is Mr. Edison's discovery? A few words will suffice to give an idea of it. It is based on the well-known fact that a wire may be heated by an electric current, the basis of many attempts to accomplish what Mr. Edison claims to have done. The reader may have seen the gas jets of the dome of the Capitol at Washington, lighted by similar means. Over each burner is placed a coil of platinum wire, which, when heated by the electric current, ignites the gas. Mr. Edison uses the coil itself as the source of light, the current sent through it being strong enough to make the coil white hot, or self-luminous. The difficulty to be overcome at this point was the liability of the wire to fuse and spoil the light, a difficulty which Mr. Edison claims to have obviated by the introduction of a simple device which, by the expansion of a small bar the instant the heat of the coil approaches the fusing point of platinum, interposes a check to the flow of the current through the coil. This automatic arrangement, in connection with an auxiliary resistance coil, secures, it is said, an even flow of electricity through the coil, and, consequently, a steady glow of pure light. If this is done economically, it is obvious that a marked advance has been made in artificial illumination."

LORD RAYLEIGH'S "THEORY OF SOUND."*

THE second part of Lord Rayleigh's highly instructive work on acoustics contains the mechanics of oscillatory motions in liquids and gases. Atmospheric air is that medium by which by far the greater number of sound waves are conveyed to our ear, since it is only exceptional that this happens through solid bodies which are in contact with our teeth or with the bones of the skull. But it is just for this reason that all circumstances are of considerable importance which influence the transmission of sound waves in the air, *i. e.*, change either their velocity, their direction, or their intensity. This part of the theory has been worked out very minutely and completely by the author. We find here the compilation and demonstration of a large number of facts which, in other works on acoustics, are hardly mentioned. The author, after having first developed (in Chap. XI.) the general laws of the motion of liquids as expressed in hydrodynamical equations, and then explained the difference between rotational and irrotational motion of fluids, passes on to the simplification of the equations, which is determined by the circumstance that with sound, as a rule, we have to do with oscillations of extremely small amplitude. First, the motion of plane waves is investigated, and it is shown that with waves which move only in one direction half their equivalent of work consists in the *vis viva* of motion, and the other half in the potential energy of the compression and dilatation of the medium. Then follows the explanation of the influence which the change of temperature, taking place with compression or dilatation of gases, exercises upon the velocity of transmission of sound. It is shown, in the manner first employed by Prof. Stokes, that if a perceptible quantity of heat could be exchanged between the compressed and dilated layers of the waves during the lapse of one oscillation, the intensity of the sound waves would very quickly decrease in their transmission and they would die away.

The subjects treated of up to this point are generally known among physicists; less known are a series of other results of the theory. The author next gives a comparatively very elegant and easily intelligible demonstration of the results at which Poisson and Riemann arrived, when investigating the propagation of sound waves for which the velocities of oscillation are no longer infinitesimal when compared to the velocity of transmission. It appears that the different layers of the wave transmit their phases with different velocities, viz., with that velocity which represents the sum of the ordinary velocity of transmission of the smallest waves and of the oscillation velocity of the particles of air oscillating in the same direction. The compressed layers of the wave, therefore, are propagated quicker than the dilated ones, thus they must gradually change the shape of the wave, and finally overtake the preceding dilated layers. What would happen in that case, whether, perhaps, a breaking of the waves of air would take place, is not yet clear, since the hydrodynamical equations apply only to velocities changing continuously.

These circumstances have not always been considered in experimental researches concerning the velocity of sound. A precise answer to the question regarding the magnitude of this velocity can only be given, if we confine ourselves to oscillations of extreme smallness.

The author has also investigated under what conditions a sound wave of finite amplitude can move forward without changing its form. It appears that this could happen only under the supposition of a special law for the compressibility of the medium, which does not correspond with the law applying to gases.

The propagation of sound in the atmosphere is subjected to yet other perturbations, which partly arise from the different temperatures and moistures of the superposed strata, and partly from the different force of winds. At the surface of water or extensive masses of solid substance the sound waves of the air are totally reflected even under very small angles of incidence; under perpendicular incidence their reflection, although not total in the strict sense of the word, is nearly as complete. For that part of the sound which enters the new medium the same law of refraction holds good which applies to waves of light. But also from a surface of hydrogen one-third of the sound coming through air at a vertical incidence is reflected, and the angle of incidence for total reflection is not larger than 15½ degrees.

The problem to determine theoretically how the propagation of sound in the atmosphere is changed by the different temperatures of its strata cannot yet be solved completely. However, it can be ascertained in what direction the most powerful effect must travel. On account of the great dimensions of the strata of the atmosphere, compared to which the wave-length of the large majority of audible tones disappears entirely, the conditions of the propagation of sound are similar to those of light. We may imagine the sound wave dissolved, as it were, into rays of sound, and then look upon each separate ray as being almost completely independent of the motion of its neighboring rays. This is no longer admissible if obstacles are in the way of the traveling sound, the dimensions of which exceed the sound wave-lengths only in moderate proportions, as is the case in our houses and rooms, with the transmission of sound through windows and doors. Then, as in the case of light under similar circumstances, diffraction takes place. The great difference in the propagation of sound and light, as it becomes evident in ordinary experience, has its cause in the very different magnitude of wave-lengths. The greater the wave-length the greater the diffraction on the passage through the same aperture. These circumstances, which are forgotten so frequently, the author considers in Chapter XIV. When sound is propagated in the unbounded space of the atmosphere the conditions of the problem are such that they allow of its decomposition into rays of sound. If a source of sound is near the ground then its sound rays are all bent in an upward direction, as Prof. Osborne Reynolds first pointed out, and those which travel in a direction parallel to the ground are mostly annihilated through friction or other obstacles. The sound proceeding from a source near the ground is, therefore, not heard far off by an observer standing on the ground. It is heard at a much greater distance if the observer or the source of sound be in an elevated position. The state of the atmosphere will have great influence upon these conditions. In dry air and sunshine the deflection of sound upward will be greater than in moist air which forms clouds above, or during rain.

The decrease of temperature in the upper strata of the atmosphere causes sound to travel at a lesser speed than in the lower ones. Now, if the wind is blowing, the velocity of which increases with the height, then, as Prof. Stokes remarks, this causes an increase in the velocity of the sound waves in the direction of the wind, and a decrease in velocity in an opposite direction; thus, for sound which travels in the former direction, the retarding effect of decrease of temperature is neutralized, and for that traveling in the latter it is augmented. We, therefore, hear better if the wind blows toward us from the source of sound than if the contrary takes place. Indeed, by an upper windy layer sound produced in the lower tranquil air may be totally reflected. This influence of wind is remarkable also because it forms an exception to the law demonstrated by myself, viz., the law of reciprocity in the propagation of sound, if the sound source and the observer change places.

The problems of the reflection of sound by fixed walls, for instance, the phenomena of whispering-galleries, speaking-trumpets, and the echo, are treated in the same manner. Although here the admissibility of the decomposition of sound into sound rays does not, as a rule, appear quite so unquestionably justified, yet the phenomena observed agree with this hypothesis on the whole.

An essential progress in the application of the theory upon experiments has been made by the author in the calculation of the influence of the open apertures of organ pipes and resonators upon their pitch. In my own demonstration of this part of the theory I had started from those forms of motion which did not render the calculation too difficult, and had then derived the corresponding forms of pipes; finally, I had so determined the optional constants of my hypotheses, that the form of pipe approached the form wished for, the cylindrical one, for instance; yet I remained confined to a few forms if I did not wish to complicate the calculation too much. Lord Rayleigh, on the contrary, supposes a given form of pipe, and has employed the maxims, developed in the first volume of his work, regarding the variation of conditions under which sound motion takes place, to determine the limits within which the true value of the desired magnitude must lie, and has, indeed, been able to draw these limits so narrowly for the most important problems, like that of the cylindrical open pipes, that practically the solution is perfectly sufficient. In this way he has been able to treat simultaneously a number of problems which hitherto had not even received an approximate solution, for instance, the determination of the proper tones of resonators of the shape of bottles with wide body and narrow neck.

Besides the problems mentioned, which are of direct importance to experimental physics, a series of others are worked out, where the mathematical solution can be completely given, such as the propagation of sound in balls, spherical layers, and rectangular boxes filled with gas, the reflection of sound from the outer surface of a ball, and the communication of sound to air by oscillating balls and strings. These problems are valuable not only as theoretical exercises, but also with regard to our understanding of physical phenomena. They are examples affording to the mental eye of the physicist a particularly perfect insight into the essence of sound motion and the changes it undergoes when the conditions under which it occurs are changed. Thus he obtains quite as good a conception of the typical behavior of sound as if he had actually seen the phenomena, and this conception will always guide him safely in cases of observation, where the exterior conditions are not as simple as they are in the theoretical example.

At the end of the volume Lord Rayleigh has placed the words: "The End." We hope that this may be only the provisional, not the definite end. There is still an important chapter wanting, viz., that on the theory of reed pipes, including the human voice. For the former, at least, the principles of their mechanics can already be given, and the methods the author employs seem to me to be particularly well adapted for further progress in these domains.

After reed pipes we would mention the theory of singing flames, and the blowing of organ pipes. In the latter case the leaf-shaped current of air, which comes from the wind case, forms a sort of reed, which oscillates under the influence of the oscillating column of air in the interior of the pipe, and which throws its air now into the interior of the pipe, and now outside.

Altogether, the whole of this important class of motions, where oscillatory movements are kept up through a cause which acts constantly, deserves detailed theoretical consideration. The action of the violin bow, and the sounding of the Æolian harp, also belong to this class.

Lord Rayleigh certainly deserves the thanks of all physicists and students of physics; he has rendered them a great service by what he has done hitherto. But I believe I am speaking in the name of all of them if I express the hope that the difficulties of that which yet remains will incite him to crown his work by completing it.

H. HELMHOLTZ.

* *Nature.*

IMPROVED MILLING MACHINERY AND METHODS.

By JOSEPH F. GENT.

AT the recent meeting of the Indiana Millers' Association, Indianapolis, the following report was made on the above subject:

GENTLEMEN: It again becomes my duty, as Chairman of the Committee on Mill Machinery and Methods, to submit to you for your consideration a few thoughts on the subject of improved milling and methods, which, at present, seem to occupy the minds of that class of millers who believe, as I do, that milling, or, more properly, the manufacture of flour, in the United States is destined to become one among the greatest interests of our country, and who are striving, by every available means at their command, to improve the products of their mills in yield, strength, and color.

The first thing to be looked after in the mill is the yield, not only of the amount of flour made from a bushel of wheat, but in mills where more than one grade of flour are taken off, the percentage of each grade so taken becomes a matter of as much importance as that of the total yield per bushel. This point settled, the strength and color are the qualities which alone must make for the brand or grade its reputation, and establish its value in the different markets where it is offered for sale.

We were told, a few years ago, that strength and color could not go together, and, I am sorry to say, there are some millers yet, who, if shown a very white sample of flour, will doubt its strength. This notion was, no doubt, derived from the fact that, under the old process of grinding, flour which was ground high and on a sharp stone, and bolted in the ordinary way on a coarse cloth, seemed to have more strength than that which had been ground on a dull or smooth stone, and heated sufficiently in the operation until all the gluten was destroyed; but the latter had the best color, hence the conclusion among millers that white flour does not possess sufficient strength. This, like other false theories, is fast being laid aside, as new and improved methods are being introduced.

There is at least one miller yet living who, if a resident of New York, would be prosecuted for cruelty to animals. I refer to the gentleman who, at the last meeting of the Michigan Association, said that he did not believe there had been any improvement in milling by the new process of making flour—that they made just as good flour 25 years ago as now.

There seems to be an impression among millers that to pulverize the flour too fine destroys its strength. This may be true of hard spring wheat, for, in order to pulverize it to the same degree of fineness as winter wheat, by the same methods, it being harder, more heat would be generated, and consequently the greater liability to injury by too close grinding, and from the same reasoning we are able to account for the fact of millers, in sampling flour, feeling the grain of the flour, and choosing the coarsest samples as the best. From my experience I am thoroughly convinced that it would be impossible to reduce it to such a degree of fineness, by the ordinary methods of pulverizing, as to injure its strength, provided the temperature was not raised too high by the process by which it was reduced.

The temperature should, I think, be increased as little as possible by the process of grinding, and the bolting should be performed as nearly as possible at 65 to 70 degrees. This, however, in many mills, cannot be regulated. Any mill so situated or constructed that the temperature cannot be brought up in winter or in cold weather cannot produce an even grade of flour, no matter what their facilities may be for controlling the process of bolting.

Grinding, granulating, or pulverizing wheat for the purpose of producing flour, middlings, and offal is a subject which requires great study and the exercise of our best judgment. To grind well is the grandest accomplishment a miller can possess, for in this he is called upon to decide some very close questions. I am well satisfied that no miller can grind high and grind correctly, with different varieties of wheat, by simply feeling the chop as it comes from the stone, and, in most cases, if you venture to express a doubt upon the matter you are told by the miller that he grinds by the offal. If this is correct just imagine yourself seated in the bran bin trying to determine which stone was doing the bad grinding two or three stories below, having worn your fingers to the quick setting and regulating the stone before entering upon this last and final test. If you are asked to examine a sample of bran and decide whether it is sufficiently scoured and free from flour, do you pour it through a spout with one hand, close your eyes, and feel of it with the other? No, you first look at it closely, and then measure and weigh it. Yet, you could as readily determine whether or not the sample of bran was well cleaned by feeling as you could whether a stone was doing perfect grinding by the same method, when grinding as high as is necessary to make first-class work.

Let us do away with all such imperfect and impractical methods, and procure an accurate pair of scales and a set of small sieves, clothed with proper cloths, take them into the mill, and weigh exactly one pound of chop from each run of burrs, and separate it by means of the sieves, and figure out the percentage of each part; by this means we can readily determine which stone in the mill is doing the bad grinding, and introduce the proper remedy at once. This method once adopted in the mills in Indiana, and our flour will gain a reputation for evenness, strength, and color never before thought of.

My word for it, gentlemen, you may introduce new machinery and new processes without number, but unless the grinding and bolting is thoroughly and systematically done the new machinery will amount to nothing.

There is one matter of which I desire to speak—that of driving stone by means of a loose spindle and self-adjusting driving-irons. I look forward to the time when the running stone will no longer be allowed to swing at random over the bed stone, but will be rigidly fastened to the spindle and put in perfect tram with the bed stone before starting, and so arranged as to be kept so. Then, in my opinion, we will have approached perfect granulation.

By the old process of low grinding, where the running stone was expected to lie on the grain with its full weight, or nearly so, it was then, perhaps, necessary for the runner to have the means of adjusting itself to the bed, in order that the whole of the kernel might be as nearly as possible pulverized to the proper fineness at the first grinding, which, however, seems, to my mind, so clearly an error, that it is unnecessary for me to produce any argument in favor of a stiff spindle.

But, while speaking on that subject, I will simply mention one or two instances where they have been successfully used for purposes identical in their nature to that of the granulation of wheat for the purpose of making middlings. For instance, a stone hung on the spindle in the ordinary way, nicely adjusted and balanced, was tried for the purpose of hulling oats before being made into oatmeal, but was pronounced a failure, thrown aside, and new machinery introduced. But after trying the new methods the stone was again taken up, mounted on a stiff spindle, and found to be far superior to anything else for hulling oats preparatory to making oatmeal. The same may be said of stone used for hulling barley; also, stones used in some mills for the purpose of treating wheat before grinding, called ending stones. They were of necessity mounted on stiff spindles, because those hung on loose bails ground a part too fine, while a part was allowed to escape untouched.

I am so thoroughly convinced of the correctness of this theory, that should we build a new mill, which we expect to do, I should adopt them for all purposes, wheat and middlings. I should, however, put in a different dress to that now used in most mills. As a general thing I am of opinion that most mills, milling soft winter wheat, are using too much grinding surface; there does not seem to be any one dress that will exactly suit the wheat grown in any two sections, where there is any material change in the climate, or where different qualities of wheat are grown. But my experience with hard Mediterranean and some of the softer qualities of winter wheat, such as white bearded, gypsy, and other smooth wheats raised in this State, has proven to me very clearly that there is one rule which may be universally adopted by millers, namely, the softer the wheat the less surface required on the face of the stone to granulate it. And I find, by reducing the grinding surface, the same proportion of middlings may be obtained from the softer varieties of wheat that can be had from the Mediterranean; but the flour does not seem to have the same strength as that made from hard wheat middlings.

I shall now speak of the process of bolting and the purification of middlings. There is the same lack of system in bolting that is found on the grinding floor of many good mills; I think partly owing to the system followed by many millwrights and mill-furnishing houses. When the millwright or mill-furnishing house is called upon and consulted about building a mill, they talk of the number of stone

the party wants—3, 4, 5, or 6 run; one smut mill, one flour packer, one middlings purifier, and four to six reels, for bolting purposes, with one or one and a half conveyors under each. They get them together, send them out, and put them up, and have the audacity to call this a new process mill, while, in reality, they are simply making the coffin and digging the financial grave of their customer, who loses his money and sells out at a discount, disgusted with the business. I do not say this to injure any millwright or mill-furnishing establishment, but I say it in the interest of the millers of Indiana.

I do not desire to be understood that a small mill cannot be built to make new process flour, but if a small mill is to be built, put in just the number of stone to do the work properly and in proportion to a large mill doing first-class work. By building the mill right, with the proper number of stone custom work can be done and one dollar more per barrel can be had for all the flour made by the mill and sold on the market. It is a mistaken idea that if a small mill is built it cannot do good work—it can, and should make the very best of flour, provided the wheat is of good quality. But to do this it must have, first, sufficient bolting surface to bolt out all the clear flour made by the first grinding; second, sufficient bolting capacity to rebolt all the returns and dustings from middlings; third, sufficient bolting capacity to bolt out all the flour from the ground middlings; fourth, sufficient bolting capacity to dust and rebolt dustings from second middlings; fifth, sufficient bolting capacity to bolt out all the flour from reground bran, and separate any fine middlings from it, if any should result from such bolting and grinding; sixth, at least one set of rolls and sufficient bolt to bolt and separate their products. This any mill must have to do good work. No less will accomplish the work. And my advice to you who contemplate building or refitting is, do not allow any man to build it for you unless the performance of these several separations are expressly stipulated in the contract. Then, if you cannot place these several parts together so as to make a mill out of them, as herein described, each in its regular order, then you should consult some one who can arrange them for you, and that man is the one who should build your mill. Where you buy your machinery is a matter of little importance, so the best is selected. And, finally, I will say, unless the same system is carried out in bolting as is done in grinding, but little will be accomplished.

I shall now speak of the separation and purification of middlings. Middlings, in my opinion, should be separated or graded by means of bolts for that purpose, clothed with suitable cloth, and two sizes or grades thrown on to machine No. 1; two grades thrown on machine No. 2; two grades on machine No. 3, and two grades on machine No. 4. The head of each of these machines may be taken for clean middlings. The middle of the two first machines should be put on machine No. 5, and the middle of machines Nos. 3 and 4 should go on machine No. 6.

Now throw the tail and cut-off from machine No. 1 on the head of machine No. 2, and the tail and cut-off from machine No. 2 on the head of machine No. 3, and the tailings and cut-off from machine No. 3 on the head of No. 4, and the cut-off and tailings from machine No 4 to rolls.

Now take the cut-off from machine No. 5 and throw it back on machine No. 2, and the cut-off from machine No. 6 to the head of machine No. 4, the tail of machines Nos. 5 and 6 to roll with tailings from No. 4.

In my report last spring I expressed myself in favor of purifiers using a blast, or blast and suction combined, and my experience with blast machines since that time has confirmed my opinion as then expressed. I am of the opinion that a machine using both blast and suction, so combined as to throw the middlings on the machine in such a manner that the blast would raise the whole body of middlings in a chamber, and allow the suction to carry away all the soft, fuzzy matter from the middlings before they come in contact with the sieve, thus having them free and round and in such a condition that a suction could have free passage up through the sieve and the middlings thereon, thus carrying away any remaining portions of foreign matter, or keeping it on top of the middlings, and passing it over the tail and away from the machine, would clean middlings with much less waste than any suction machine.

I have been a close observer in this matter of cleaning middlings, and have invariably found that wherever the cloth is covered with middlings on a suction machine, as is always the case at the head of the machine, the middlings are not properly cleaned. The reason of this, I think, is plain. The fiber and fluff, not being previously removed by means of the combined blast and suction applied before the middlings fall on the cloth, clog the meshes of the cloth as well as the small openings between the particles of middlings, thus allowing the middlings to fall through the cloth, and beyond the control of the suction, without being thoroughly cleaned.

Mr. David Gibson, of Indianapolis, spoke in highly eulogistic terms of Mr. Gent's report, and moved its acceptance, as well as that the thanks of the association be tendered Mr. Gent for his able paper. The motion was adopted.

In lieu of a report from the committee on grain for milling, Mr. Gibson made a few remarks to the effect that he thought it the peculiar duty of the millers of the State, both for their own and the farmers' benefit, to impress upon the latter the importance of turning their attention and energies to the cultivation of the bearded red wheats, which experience has shown to be the best adapted variety for this soil and climate, and to this end he recommended that the millers should pay a higher price for this particular variety, and instruct the farmers as much as possible how to bring up their yields to something like the English, and thus get the markets of the world. He stated that there were over 100,000,000 bushels of wheat used annually in England more than they raised, and which our country could and ought to furnish, either in the shape of wheat or flour, from the surplus of our 400,000,000 bushels of annual production. He said the reason we have not heretofore sold flour in England was because we were not manufacturing as good an article as they could make from the same or even inferior wheat by the slower process there in vogue, but now we are sending a great deal, and their merchants and bakers are finding it out. We can manufacture cheaper than they, and all the time, and while our facilities for so doing are constantly becoming better, theirs are growing less. He stated that he was refusing to purchase Fulse wheat, but pay more for bearded red wheat, if necessary; however, we can use Fulse wheat, and make money out of it, but only by paying ten cents per bushel less, by properly improving our mills. We can, one and all, make flour of a quality which will enable us to pay an A No. 1 price for such wheat as we require.

Mr. Iglehart thought it well that this association should recommend farmers to discontinue the use of wire binders; he has experienced a great deal of annoyance and damage from this source, as short pieces of wire so used frequently pass through his stones and into the bolting chests, where they create sad havoc with his cloths.

Mr. Elles stated that he had endeavored to induce the farmers in his section to plant Mediterranean wheat by selling them Mediterranean seed wheat, and had succeeded in disposing of some 300 bushels in this locality for that purpose.

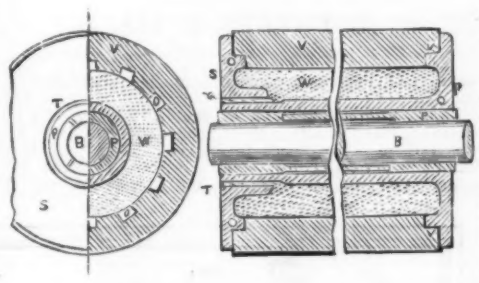
Mr. Gent moved that a committee of two be appointed to have samples of the different varieties of wheat analyzed, said committee to report at the next meeting of the association.

PORCELAIN ROLLERS FOR MILLING.

AN interesting patent case has lately been tried in England in the High Court of Justice, Chancery Division, before Mr. Justice Fry—Wegmann *vs.* Corcoran, Witt & Co.

This was the trial of an action of considerable interest to millers, involving as it did a patented machine now in considerable use.

The plaintiff, M. Wegmann, is a member of the firm of Wegmann, Bodmer & Co., millers, in a large way of business at Naples. The defendants are well known millwrights and engineers of Mark-lane, London. The subject matter of the action was a mill designed by the plaintiff with the object of extracting flour from middlings to the greatest extent. Prior to the date of the plaintiff's patent but little effort had been made to obtain flour by the treatment of middlings. Almost all the milling in this country was at that time done by stones, but it occurred to the plaintiff that by squeezing the meal or middlings between rollers a much better effect would be produced. He did not, however,



PORCELAIN ROLLERS FOR MILLING.

claim the merit of being the first to treat middlings by rollers, because iron rollers had previously, to a small extent, been unsuccessfully used in this country.

About the year 1869 M. Wegmann obtained a roller machine from Messrs. Escher, Wyss & Co., which had three pairs of iron rollers, one above the other, the two top pairs being smooth, and running at differential speed; the lowest pair had grooved surfaces, the grooves running parallel with the axis. These rollers had also differential speed. The working of this machine was unsatisfactory. He next constructed a machine of his own at Naples. This machine had one pair of metal rollers, one fixed, and the other resting in adjustable bearings, pressed toward the fixed roller by a combination of lever and weights, and running at differential speed. M. Wegmann found in practice that slight pressure was needed to reduce middlings, and, after numerous experiments, he found that by using equal speed with the rollers the result was more beneficial. So far, the rollers were of cast iron. M. Wegmann next turned his attention to steel.

He ordered a pair of such rollers from Guppy & Co., of Naples, but they were not satisfactory, having become out of truth in hardening. He next endeavored to coat rollers with watch springs which he obtained from Geneva. The springs were wound round the rollers, and the surface ground on a stone. By this means he obtained a true hard surface, but he now found that he could not drive the adjustable roller by friction only. He accordingly returned to the use of Guppy's steel rollers for a time.

The result of all these experiments showed him that what he wanted as a material was something which should combine the hardness of steel with a porous or biting surface. Glass rollers turned with a diamond and ground were next tried, but with not much success. He then tried marble rollers which he obtained in Naples, and, until they became worn, they were satisfactory.

At last he hit upon porcelain, and, after visiting several porcelain factories, he succeeded in getting some rollers made at the Ginori Works, in Florence. The result was satisfactory, and, after some experiments, the machine became a success. He then proceeded to obtain patents for his invention. In England he obtained two through his agent, Mr. T. N. Palmer. The first of these was dated 6th of March, 1874, No. 823; the second, 25th November, 1876, No. 4571, and these were the patents upon which the action was brought. The infringement complained of was the sale by the defendants of mills advertised as "Weber's Patent Porcelain Roller Mills." This mill was the subject of a patent granted to Mr. Wirth, 17th November, 1877, No. 4305.

Specification No. 823, 1874, says, "The squeezing rolls are to have a surface consisting of material containing so much silica as not to color the meal or flour. I prefer to make them of iron, coated with china, and finely turned with diamond tools;" and claim the second of the three is for "the application of squeezing rolls having a surface consisting of material containing so much silica as not to color the meal or flour, and so as to have the hardness required for the purpose set forth."

Specification No. 4571, 1876, relates to improvements in the machine described in the previous specification of 1874, these improvements consisting "in the use of porcelain rollers, combined with means for imparting to the said rollers a differential speed," the claim being for this combination.

Specification No. 4305, 1877, relates to the treatment of grain in roller mills, and "consists in means of relieving the axles of such rollers from pressure in their bearings, in the construction of porcelain rollers for such mills, and in apparatus for separating the bran from the mealy portion of groats or such like material that has passed through the roller mill." The relief to the bearings carrying the porcelain rollers is secured by setting the rollers up together by means of narrow disks or friction rollers running against the crushing roller spindle, and pressed up by screws at the two ends of the spindle carrying them, the bearings of the crusher rollers being free to move in their guides. The porcelain rollers are described as constructed according to Figs. 5, 6, and 7:

"B is the roller axle, fitted with the taper sleeve, P, made in segments which can be separately driven as keys between the axle, and another solid sleeve, Q, which is cast in one with an end disk, R. Another end disk, S, is secured to the sleeve, Q, by segmental keys, T. Both the end disks, R and S, have internal projections, U, of dovetailed shape, which enter corresponding notches in the cylindrical porcelain shell, V, that forms the external circumference of the roller. Also, the ends of the shells, V, are slightly coned, and the peripheries of the disks, R S, are correspondingly coned to fit over these ends, as shown at *r r*. The porcelain shell, V, having been placed on the disk, R, and the disk, S, having been then placed on the sleeve, Q, by the segmental keys, T, cement, W, is run in through holes in one of the end disks," and the roller is then secured by segmental keys, P.

The claim is for the method of relieving the roller bearings of the pressure on the roller faces, and for the method of constructing the roller as described.

The first porcelain roller mill on the plaintiff's system which was introduced into England was put up at the North Shore Mill, in Liverpool, in 1875. Another was erected in the same year at Pimm's Mills, at Wandsworth, where it is still at work. Originally the plaintiff's mills had not differential speed, but such arrangement was introduced in 1876.

The Attorney General, Mr. Henry Matthews, Q.C., Mr. Aston, Q.C., and Mr. Carpmael were for the plaintiff, and Mr. Fischer, Q.C., and Mr. Fryer for the defendants.

The case lasted several days, and many witnesses were examined. The defendants did not go into their defense as to novelty and infringement, but relied upon their objection to the sufficiency of the specification. The plaintiff's patent of 1876 was abandoned early in the case as unsustainable, so that, really, the action turned upon a narrow issue, and it was upon this that almost all the evidence was taken.

Mr. Justice Fry, in giving judgment, came to the conclusion that the plaintiff's specification was not sufficient. Patents, he said, were granted, upon the bargain that the patentee should communicate to the public that which would enable not only a man of science, nor even a man possessing the knowledge the head of a manufacturing firm might have, but also a skillful workman of ordinary intelligence, to construct the article for the use of which the monopoly was granted. His lordship observed that the utility and novelty of the plaintiff's invention, which, for the purpose before him, he must assume to be established, consisted in the application of a particular material te the construction of rollers for a purpose for which rollers had been previously used; that the usefulness of the material consisted in its being very hard, having an even and yet not slippery surface; that these qualities in the material were due not merely to the large proportion of silica in its composition, but also to its having a sufficient proportion of alumina in its composition; that the hardness of flint and the cohesion of clay were alike requisite. He considered the specification was misleading, among other ways, in that it would suggest to an ordinary mind that the rollers were to be of iron, with a thin coating, such as the enamel put in iron saucepans, and that there was nothing to indicate the proportion of silica required, nor that the important substance, alumina, was required to the extent of about one-fifth of the whole. The plaintiff, it seemed to him, had claimed a whole genus, of which he only knew one species; he had attempted to cast his dragnet wide enough to include all other articles belonging to the genus which might be discovered, and thus had claimed too much. The patent was void for ambiguity, and his lordship dismissed the action. A special order under the Patent Act was made as to costs, giving the plaintiff the cost of the defendants objections which were abandoned.

FROM the monthly statement of the Chief of the Bureau of Statistics to the Secretary of the Treasury for November, 1878, the excess of exports over imports of merchandise appears to have been as follows: Twelve months ended November 30, 1878, $309,309,741; twelve months ended November 30, 1877, $140,723,629.

THE SACHSENBERG HOT AIR ENGINE.

THE accompanying engravings represent an engine built under the Stenberg patent by Messrs. Sachsenberg, Rosslau, Germany:

Fig. 1 is a front view, Fig. 2 a longitudinal section. A

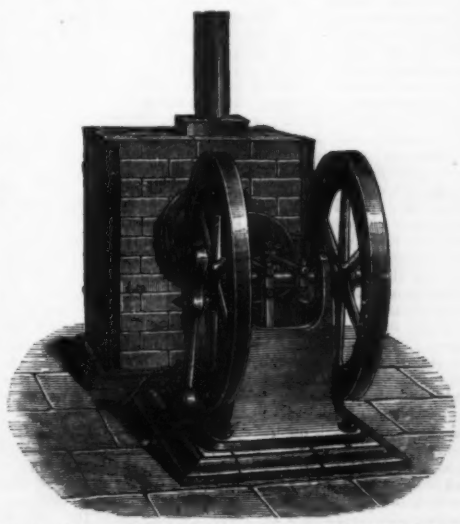


FIG. 1.—HOT AIR ENGINE OF SACHSENBERG & CO.

cast-iron cylinder, *a*, surrounded by a refrigerator, is open at one end and closed air-tight at the other end by the double-walled fire box, *b*. In the cylinder, *a*, move the pis-

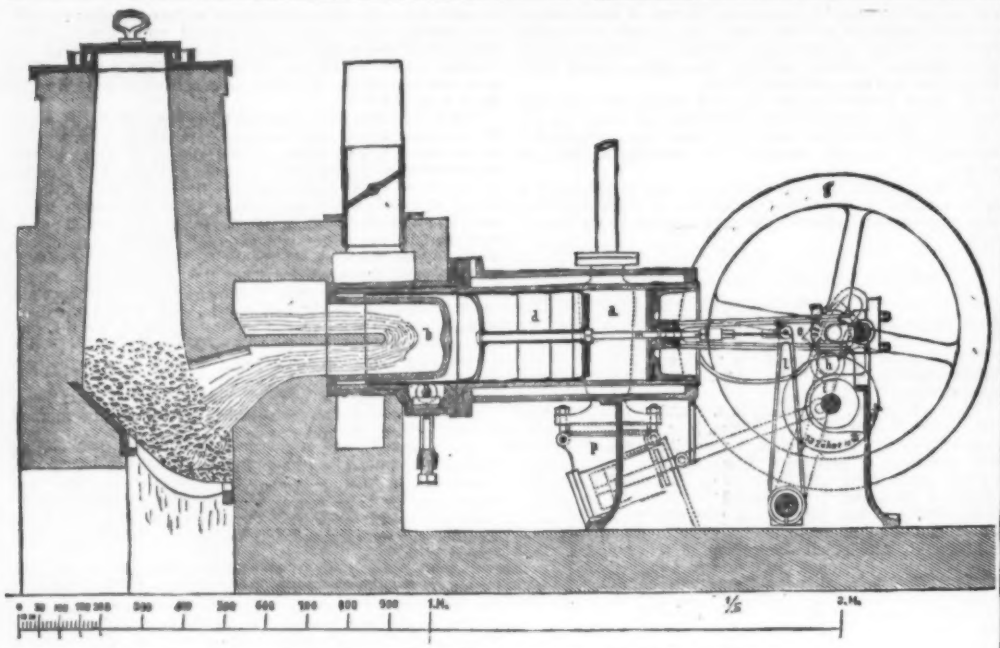


FIG. 2.—HOT AIR ENGINE OF SACHSENBERG & CO.

ton, *c*, and the hollow cylinder, *d*, smaller in diameter than the large cylinder, *a*. It is closed toward the piston, *c*, but its bell-shaped end toward the fire box, *b*, is open. The piston operates by means of rods, *e*, and cranks, *f*, on the shaft, which carries two fly-wheels. One of the latter is provided with a bolt, *h*, acting on the loop of the lever, *i*. The latter, in connection with a lever, *l*, attached to the shaft, *k*, and the rod, *m*, regulates the motion of the cylinder, *d*.

The mode of operation is as follows:

When the piston moves toward the fire box the cylinder, *d*, is carried along, till it, forced by the peculiarly-formed loop of the lever, *i*, comes to a standstill before the fire box, while the piston finishes its stroke. Hereby the cold air in the cylinder is compressed. As soon as the piston starts on its return the cylinder, *d*, is suddenly pulled after the piston, and the air comes into contact with the fire box. Expansion of the air is the result, and the piston is pushed out to the extremity of the cylinder, *a*, where the air is cooled again.

The machine is said to require little attendance and is easily cleaned. It requires per hour and horse-power six pounds of coal and thirty gallons of water for cooling, making about 100 revolutions per minute.—*Maschinenconstructeur.*

AMERICAN MACHINERY IN ENGLAND.

VISITORS to the Smithfield Show cannot fail to notice the number of American manufacturers there represented, either direct or by their agents in England, and amongst reputed English goods exhibited many of them bear an unmistakable look of American make or origin. But the houses courting English support at our great show do not, by any means, exhaust the number of firms established in London devoted to the sale of United States productions. In a country like our own, which boasts of some of the finest engineers in the world as makers of machinery, it is a bold venture on the part of our "cousins" to settle in our midst with the very goods in which we consider we stand prëeminent. Yet we have firms established in London whose dealings are confined entirely to American machinery and tools. One of these houses—Messrs. Charles Churchill & Co., of 28 Wilson street, Finsbury—have been located there for many years, adding continually to the number of appliances in that important branch of trade, until their catalogue of American machinery has assumed considerable proportions. It is interesting to look through their warerooms and see the immense number of such goods imported by the firm. Taking the large machinery first, the productions of the Pratt & Whitney Company are the most noticeable. This firm, who rank high in their country as machinists, make no less than eighty varieties of lathes, many of which Messrs. Churchill keep in stock. These embrace a wide range, from the smallest treadle tool for the amateur to the largest intended for engineering purposes. The firm has sixteen sizes of planers, eight sizes and varieties of upright drills, five sizes of screw machines, of bolt-cutting four sizes, five different milling machines, horizontal drills of five, six, and eight spindles, profiling machines, broaching presses, drop hammers, tilt hammers, etc. Vises are also largely imported, and consist of milling machine vises, Stephens' patent parallel vises, Hall's patent sudden-grip vises, Parker's patent vises, amongst which are found the swivel or rotary, the swivel jaw, the rocking swivel, the patent planer and shaper vise, the saw filer's vise, and a patent jeweler's vise. We find the Morse Company's twist drills in many varieties, their stocks and dies, and other tools made by this well-known company. Of lathe chucks the number are too numerous to mention in detail, as these are tools for which Americans seem to have a particular *penchant* for inventing, but I may notice the "Victor" drill chuck, the "Acme," the "Oneida," Morse's adjustable, Cushman's new, the Pratt & Whitney's, new "Combination," and the Horton car-wheel chuck, as being great favorites in the States, and all possessing excellent points. Then we have emery wheels of the "Union Stone Company," which are said to be composed exclusively of mineral substances free from glue, shellac, or any other gummy materials, and will run at half the speed of other wheels, and cut faster, one of them being a very little affair, intended for amateur use, and mounted on the "Dexter" treadle, which with ordinary treadling admits a speed of 3,500 revolutions of the spindle per minute. Fretwork must enter largely into American decorative uses, judging from the number of scroll saws Messrs. Churchill exhibit. One of the most meritorious is the "Fleetwood," recommended for its simplicity of construction, and the ease and rapidity with which it works. The "Challenge," with non-tilting table, double treadle, and boring and drilling attachment, is no less noticeable, and the "Dexter's" are perhaps not overestimated by the makers when called a triumph of simplicity and good work. There are many details in these machines of excellent ideas which there is not space to explain. Then there is the Barnes patent foot-power scroll saw, the combined foot-power scroll and circular saw, and a new one for the amateur named the Richardson fret saw, with a drilling attachment, non-tilting table, the principal parts being made of steel, and weighing, with box, only 30 lbs. This is also said to be very cheap. Numerous other tools, etc. (everything of American manufacture), are to be seen in Messrs. Churchill's show-rooms, to which I must refer your readers for further information as to their extensive stock.—*Ironmonger.*

WAR ROCKETS.

THE government of India, recognizing the value of war rockets in such operations as the possible campaign in Afghanistan, have requisitioned the Royal Laboratory Department, Royal Arsenal, Woolwich, to supplement former issues by a supply of rockets larger and more powerful than those in ordinary use. The department is, accordingly, manufacturing the pattern known as the 6-inch rockets, the largest in the service, in which very few exist. It is, as its name implies, 6 inches in diameter, and its length is nearly 4 feet. The bursting charge in the head, in accordance with the latest improvements, will consist of gun-cotton, occupying about one-third of the case, the remainder being filled with firing composition. A strengthened attachment of the head recently tried at Shoeburyness is adopted, and it is proposed to introduce, in case of need, the new delayed-action fuse. Like all the war rockets now made, they are without sticks, rotation being imparted by the escaping gases, and they may be fired either from troughs or tubes. Twenty of these rockets are to be used for experimental purposes, but 100 will be sent out as soon as possible to the army in North-West India.

FAURE'S PLATE AND SAUCER MACHINE.

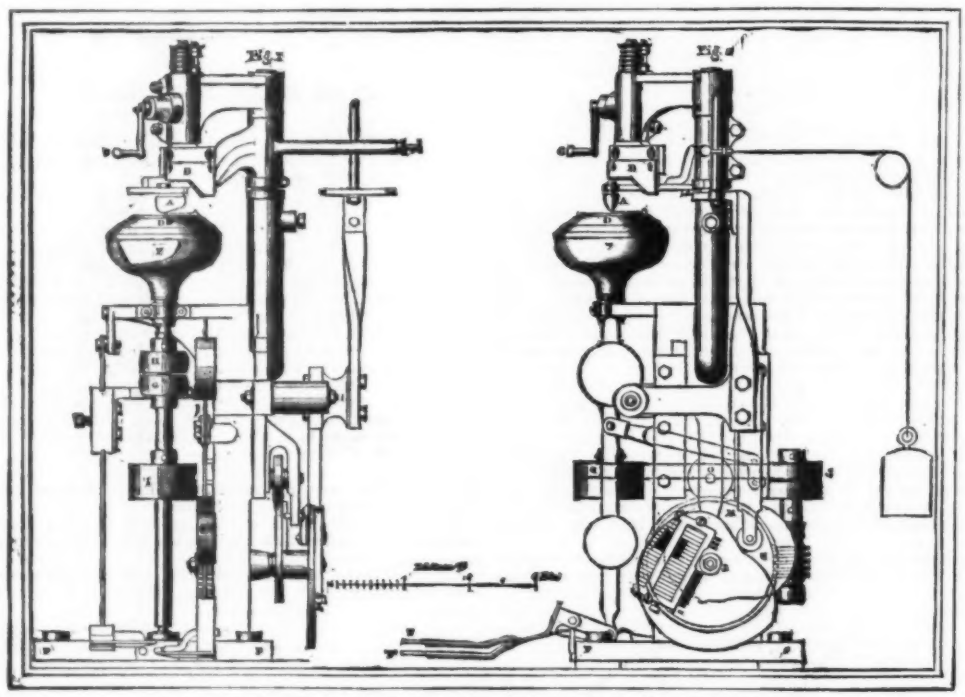
THE potter's wheel of olden times has long ago disappeared from our potteries, and its place has been filled by machines performing automatically all the operations for which manual labor was formerly required. Few of those machines have been as extensively introduced as those of Mr. Faure, of Limoges, France. As originally constructed, the machine only cut and centered the circular sheets of plastic clay; the shaping had to be done by hand. Various improvements have since been made by the inventor, and we illustrate to-day a machine by which plates, saucers, etc., of any desired form, are made at the rate of five hundred per day.

The machine is operated by steam by means of the pulleys, G and H. It rests on a support, P, and consists of two distinct parts. The lower part contains all the rotating parts, while the upper part oscillates vertically.

On the extremity of the axis of the pulleys, G and H, is provided a support, E, in such a manner that the rotary motion may be transmitted to it at will by operating the treadle, F. On it are placed the moulds, D.

A and B are shaping tools or dies. A forms the bottom and side of the plate, while the brim is formed by B. I and J are pulleys turning an endless screw engaging a toothed wheel. The shaft of the latter carries eccentric disks, L and M, which raise alternately the shaping tools, A and B.

These machines have been adopted by leading manufacturers throughout France, and a gold medal has been awarded to the inventor.—*Bulletin de la Société d'Encouragement.*



FAURE'S PLATE AND SAUCER MACHINE.

THE LARGEST GUN IN THE WORLD.

HERR KRUPP has lately completed a 40-centimeter or 16-inch gun. The most powerful piece of ordnance which had previously been constructed in the factory at Essen or, indeed, in any other Continental workshop, was the 35·5 centimeter Krupp gun, which was tried in July last on the ranges at Meppen, with very satisfactory results. The 40-centimeter gun now finished is naturally a far more formidable weapon than even its immediate forerunner. While the total weight of the 35·5 centimeter piece is about 50 English tons, that of the 40-centimeter gun is nearly 70 tons—the length of the former piece being 29 feet, and of the latter 33 feet. The heaviest projectile launched by the 35·5 centimeter gun—the steel or hardened iron shell, namely, used for firing against armor—weighs 1,155 lbs.; while the steel projectile discharged from the 40-centimeter gun weighs 1,606 lbs.; the charge used with the former consisting of 253 lbs., with the latter of 352 lbs., of prismatic powder. The muzzle velocity imparted to the projectiles is the same in both guns, being very nearly 500 meters per second; but while at a short range the 35·5 centimeter gun sends its shell through 24 inches, and at 2,000 yards through 18 inches of iron armor, the new gun will give at the same ranges a penetration, it is calculated, of 28 and 21 inches respectively. It appears, therefore, that while the weight of the gun is augmented by about one-third, its penetrative power is only increased by about one-sixth.

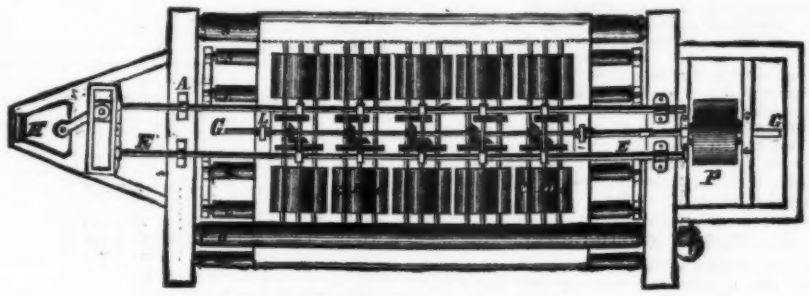
[Textile Manufacturer.]

CROSS-RAISING MACHINE.

MACHINES for cross-raising the nap of cloth are no novelty either in the woolen or cotton industry; for the latter an effectual machine exists, which carries bands of cards by a circular motion in one direction over the face of the cloth; these bands have, however, more a brushing than a raising action. To increase the latter and enable the finisher to put any desired amount of nap upon the cloth, Messrs. Delamare & Chandelier have invented a machine, which we are the more inclined to describe and illustrate in our pages as the Industrial Society of Rouen have furnished a very favorable report upon its performances. In this machine the cloth is carried by and is stretched across a pair of rollers; over the suspended part of the cloth rollers covered with metallic cards revolve in a direction at right angles to that of the traverse of the fabric; these rollers have at the same time a to and fro motion across the piece, so as to insure their action upon the whole width of the piece.

Our illustration, showing a plan of the machine, which we have copied from the *Bulletin* of the above-mentioned society, will serve sufficiently to explain the working of this machine, although on a few points of detail it is not very explicit; for instance, we cannot see any provision for supporting the outer ends of the axles of the rollers C, D C D, etc. Across the machine are placed a certain number of guide rollers, *a, b, c, d, f, g, h;* the roller, *h*, is covered with cards and driven by gearing in order to convey the cloth

forward. To give the cloth a certain tension the roller, *b*, rests upon it, and is likewise covered with cards, whilst upon its axle a pulley is fixed, over which a strap and weight are placed to give it the required drag, at the same time allowing the cloth to pass on; the rate of traverse of the cloth, and, therefore, the time during which it is operated upon by the raising rollers, may thus be regulated by the weight. C C' are the raising rollers, actuated by pinions as shown, and resting upon the cloth in the part where it is suspended by the rollers, *c*, *d* and *f*, *g*. These rollers are in pairs, so as to be able to have them covered with cards of different fineness, according to the degree of action desired. Over each pair of raising rollers is placed a larger clearer roller, D, also covered with cards. The rollers and clearers are carried by a frame consisting of two guide-rods, E, E, connected together at one end by the rectangular slot-link,



CROSS-RAISING MACHINE.

F, by which the crank, H, driven from an upright shaft, gives the required reciprocating motion. The rotary motion for the rollers and clearers is obtained by means of bevel wheels and pinions from the shaft G, G; this shaft participates in the to and fro motion of the rollers and guide-frame, and is square in section where it passes through the driving pulley.

The pairs of tension rollers, *d*, *c* and *g*, *f*, are each carried in a vertical frame, whose lower parts rest upon eccentrics fixed upon a shaft, and which, by means of a lever, can be set at will, so as to raise or lower the frame according to the degree of pressure the rollers are to exercise against the cloth; the two tappets being upon the same shaft the pressure is thus equal upon both edges of the cloth.

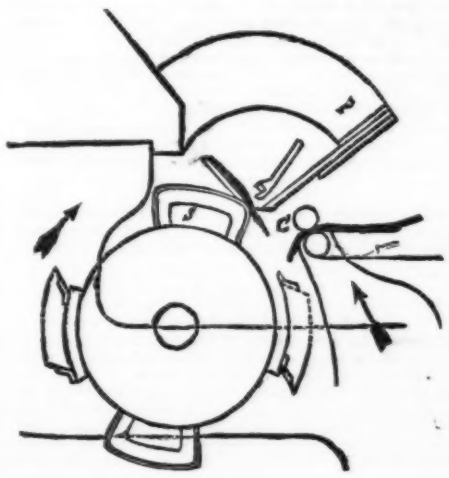
The length of nap to be raised determines, of course, the production of the machine, but it is stated that on an average seven to ten yards can be raised per minute.

WOOLEN LOOMS IN GERMANY.

WOOLEN cloth is manufactured in Germany and Belgium almost exclusively upon a low loom, with the slay swinging from below, and the shuttle picked across the race by a spring. The English style of woolen loom is seldom used, and is considered antiquated; the former makes a better machine and a lighter loom, but hardly gives a greater production. These looms have been introduced, and for years almost exclusively made, by the large establishment of M. Schonherr, of Chemnitz, now a joint stock company. Last year 736 such looms were manufactured against 550 in the previous year. This company has just distributed a dividend of four per cent., after writing off £5,000 for depreciation. This does not look like bad times!

PIERRARD'S IMPROVEMENT IN COMBING MACHINES.

IN Heilman's combing machines with oscillating combs the entry of the sliver into the needles is produced by the descent of the comb upon it, while the sector underneath keeps it up. It, however, often happens that, when the sliver is rather thin, the comb does not push it far enough, and a space is left between it and the sector, into which fibers collect, and then when accumulated pass on with the sliver, producing uneven yarn, which is specially the case



when combing wool. Generally a small roller is introduced with the object of pressing the sliver down, but this is not always effectual. To obviate these inconveniences the inventor makes the comb a fixture, as shown at P in our illustration, which in no way interferes with the functions of the circular comb. When the sliver has been acted upon by the combing cylinder, it is thrown up by the angle of the leather-covered sector, S, and is forced into the fixed comb, thus insuring a certain and reliable combing. The arrangement is sufficiently evident from our illustration as not to require any further explanation.

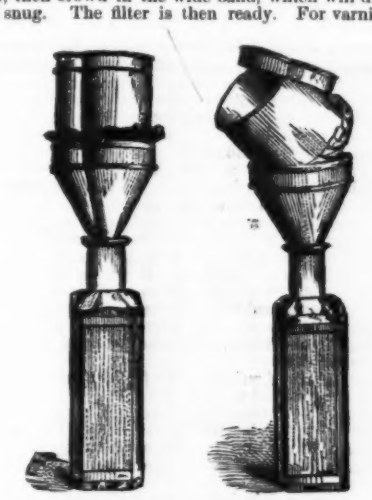
PLAITING SPUN YARN.

LET the operator take eight strands, and, after fastening them, proceed as follows: Divide the strands, four to each side; cross the two center ones, the left over the right, holding them firmly between the thumb and fingers of the left hand; now bring the top strand from the left side round the back, under the two top strands on the right side, and over the two lower ones. Holding these last three with the right hand, let all go with the left. Now bring the top strand from the right side in the same manner, under the two top and over the two lower ones, including the one previously brought from the left. Holding these three firmly with the left hand, let go with the right, and so on to the end. This may seem difficult, but it can easily be managed with a little patience. The rule for plaiting square packing with eight strands is under and over two; for 16 strands, under and over three, and for 24, under and over four. Strips of India rubber are often plaited in the center, as it makes excellent packing for air pumps.

PLATT'S UNIVERSAL FILTER.

I TAKE pleasure in sending you a cut of my Universal Filter. I use it as follows:

For varnish or albumen I use an ordinary tin funnel; I first solder a tin band one inch wide on the top, then make the adjustable top of tin to fit it loosely; this consists of another band two inches deep. Spread a piece of cotton flannel over the narrow band on the top of the funnel, with nap side up, then crowd in the wide band, which will draw the flannel snug. The filter is then ready. For varnish, wet



the flannel with alcohol; for albumen, use a piece of muslin if the flannel does not filter fast enough.

You will at once see it will do all kinds of straining or filtering, as anything, from the coarsest wire sieving to the finest muslin, can be used.

I have used it for collodion, varnish, cream, milk, fat, paint, albumen, honey, and a host of other things I will not mention.—S. L. PLATT, *in Philadelphia Photographer.*

BROMIDE OF COPPER—ITS PREPARATION AND PECULIARITIES.

OF the various branches which find a place in the laboratory of the photographic experimentalist the most recently introduced is the bromide of copper; and, as it presents certain features which seem to promise for it a more extended sphere of utility, and as it is, moreover, a rare and somewhat expensive salt, we have considered it worth while to say a few words upon its bases and economical preparation.

The principal practical use to which it has hitherto been applied is, as our readers will be aware, in the process of intensification recently made the subject of careful study, and fully described in our columns, by Captain Abney, and which we have had occasion to refer to more than once as a useful addition to the already numerous list of methods for obtaining density under exceptional circumstances. Mr. Warnerke has also spoken of cupric bromide in connection with the preparation of emulsions, and claims for it, when employed in that capacity, a special advantage in securing the impression of very feebly-illuminated details. In this direction, however, we have not yet heard much of its use—very possibly on account of the difficulty in obtaining the salt.

Its application to the purposes of intensification depends upon its property of attacking or bleaching the developed image by converting the metallic silver to the state of bromide—a property which it shares in common with its fellow haloid, the chloride. Its action, however, is different from that of the latter; for, whereas the application of a solution of silver nitrate to the bleached image produced by the bromide invariably results in a very remarkable increase of density, the same course of treatment following the bleaching with chloride produces little or no effect under ordinary circumstances. There is, however, a certain amount of resemblance between the two salts in general chemical properties; but the bromide appears to be a much less stable compound than the chloride, bearing a strong analogy in this respect to zinc bromide. Like chlorine, bromine forms two compounds with copper, one of which contains twice as much of the halogens as the other. In the case of the chlorine compounds their composition is pretty accurately known, and they are formulated as $CuCl_2$, Cu_2Cl_2, respectively. But the bromides have received comparatively little study; hence we are not so certain of their composition, though the formulæ CuBr and $CuBr_2$ are usually accepted.

Those of our readers who have had occasion to use the better-known cupric chloride, which is obtained in pure crystals, will be aware that commercial samples are almost invariably contaminated with traces of the *cuprous* salt, as evidenced by the presence of a white insoluble sediment in the solution of the crystals. The same sediment is formed if the solution be left exposed to the atmosphere, and is due to the loss of a portion of the halogen and consequent reduction of the chloride to the state of sub-chloride, and ultimately, in all probability, by the hydrated oxide. To similar reactions we may trace the formation of the insoluble matter found in all samples of zinc bromide—at least in *all* samples we have seen; and there is every reason to believe, though from the nature of the salt it is more difficult of recognition, that the same or similar changes occur in cupric bromide. On account of this instability or uncertainty of composition it is, therefore, advisable in using bromide of copper to keep it in alcoholic solution (as is customary with the zinc salt), the strength or combining value of which is ascertained by actual experiment.

The simplest and best way of preparing cupric bromide is, no doubt, by the double decomposition of cupric sulphate and baric bromide, the insoluble baric sulphate being easily filtered out, leaving a solution of pure cupric bromide. But bromide of barium is a rather expensive salt, its cost being at least four or five times that of bromide of potassium at retail rates; therefore by adopting the method we propose the substitution of the latter salt forms equally as simple and as effective a plan as the other. The method described for the preparation of the bleaching solution for intensifying consists in mixing hot saturated aqueous solutions of sulphate of copper and bromide of potassium respectively. This forms a solution of bromide of copper, out of which, upon cooling, a large proportion of the sulphate of potash which results from the interchange of elements crystallizes, and the portion which remains in solution produces no ill effect when the solution is used for the purpose in question. In order to utilize the cupric bromide for emulsion purposes it becomes necessary to free it from the remaining traces of a potash salt, and also to drive off the water, and this entails an amount of trouble which many would be loth to incur.

If we substitute alcohol for water the insolubility of the two salts in that menstruum forms an obstacle, though by placing them together in a bottle with alcohol a slow and imperfect interchange of parts takes place. To bring about a perfect decomposition we have adopted the following plan: Weigh out equivalent proportions of the two salts, or, rather, one equivalent of sulphate of copper to two of bromide of potassium; these will represent nearly equal actual weights, or, to be as nearly exact as possible, fifty parts of the first to forty-eight of the second. Reduce them separately to a fine powder, and when this is effected let them be mixed intimately in a glass mortar. The pulverization of the sulphate of copper almost entirely removes its blue color, and, when added to the bromide of potassium, the mixture is at first nearly pure white; but as the two powders are worked together with the pestle the color rapidly changes to a dirty brown, and the whole gradually loses its powdery character and assumes the form of a soft, coherent mass. The latter effect is due to the liberation of the water of crystallization of the cupric sulphate, which forms nearly one-fifth of the total weight of the mass, and by its presence enables the two salts to react upon one another rapidly and completely. The soft, brown magma must be rubbed down with the pestle until it assumes a smooth, even appearance, and presents no white specks of undecomposed material. This will occupy four or five minutes, after which it may be set aside in a warm place for some time to drive off as much as possible of the moisture. If artificial heat be resorted to the temperature should not be raised above 180° to to 200°, as at this stage the cupric bromide seems to be peculiarly liable to decomposition, as is proved by the strong odor of liberated bromide experienced if the temperature be raised only as high as 212°.

The mass now consists of a mixture of sulphate of potash and bromide of copper, and very probably also sub-bromide; for the faint odor of bromine, which is easily detected, shows that at least a partial decomposition of the $CuBr_2$ has taken place. If a high temperature be applied the odor of bromine is much more powerful, whence it may be assumed that heat favors this decomposition. The bromide of copper has now to be freed from the useless potash salt. This cannot be satisfactorily performed by the amateur by crystallization from an aqueous solution, though a large proportion of the sulphate may be removed in this manner in consequence of its low degree of solubility: and even to only partially purify the bromide in this manner entails, as we have shown, a good deal of unnecessary trouble. If instead of water we employ alcohol, or even ether, the difficulties are entirely removed; for the sulphate of potash, being perfectly soluble in these two menstrua, merely requires separating by decantation or filtration, leaving the bromide in solution. Further: this solution, after its strength has been ascertained by volumetric analysis, may be used by direct addition to the collodion, and thus all necessity for evaporation is obviated.

This purification is best performed by shaking up the mass of mixed salts in a bottle with a small quantity of alcohol or ether, just sufficient to cover it, and, after a few minutes' rest, decanting the liquid portion and replacing it with fresh alcohol or ether. By repeating this operation a few times the whole of the bromide is extracted, leaving the sulphate of potash as a dirty, granular sediment. We prefer the use of successive small quantities of the solvent to a direct addition of a larger quantity. As a farther safeguard against impurity—though we do not suppose the presence of a small quantity of sulphate of potash would work any great harm—the solution may be passed through filtering paper, and is then stored away in a well-stoppered bottle.

If it be considered preferable to obtain the product in the solid state it is an easy matter to evaporate it to dryness, but it is impossible to crystallize it. We are, perhaps, incorrect in saying even that it may be evaporated to dryness, for a very lengthened application of heat fails to do this, as the substance appears to pass directly from the state of *solution* to that of *fusion* in the same manner as zinc chloride under similar circumstances; and it is only when the heat is removed and it is allowed to cool that it becomes solid. The evaporation is conveniently performed over a water bath, and we should recommend the operation to be carried out in close proximity to a fireplace with a good draught, otherwise the combined fumes of methyl (we have employed methylated solvents) and the disengaged bromide produce a painfully-irritating effect upon the eyes, and this is especially the case when ether is employed.

A very handy means of temporizing a water bath consists

in removing the inner boiler of a glue kettle and placing an evaporating dish over the mouth of the outer casing. It is almost needless to warn our readers that the light must be removed from below the kettle before commencing the evaporation, or an explosion will be almost inevitable, especially in the case of ether. If the water in the kettle be raised to the point of ebullition sufficient heat will remain after removing the light to carry on the evaporation with rapidity and regularity. When the whole of the solvents have been driven off the residue will present the appearance of a dark brown or black incrustation on the sides of the dish—to all appearance quite dry; but, if a glass rod be plunged into it, it will be found that a sort of skin has formed on the surface, while the under portions are still liquid. Upon cooling, however, it solidifies into a dark-colored cake, or slag, which changes to various shades of brown and brownish yellow when powdered.

A very noticeable peculiarity of this dark-colored product is the variety of color it presents under different circumstances. Dissolved in alcohol, ether, or collodion, it colors the solution a peculiar yellowish tint of brown. Dissolved in a considerable quantity of water, it forms a bright green solution; but in a minimum quantity the color is again brown, but of an entirely different tint to the alcoholic solution. If the weak aqueous solution be gradually evaporated a point is reached at which it becomes brown while hot, but regains its green color upon cooling. So remarkable is this change of color that if a porcelain basin be rinsed out with a solution so weak as to scarcely leave any perceptible trace of color, and placed over a Bunsen burner or other source of heat, as it dries it will assume a deep brownish-black color, and this in turn gives place, when the basin is allowed to cool, to a delicate lemon-yellow. Similar phenomena are common to many of the copper and other salts, and are due to the hydration and dehydration of the substance; but the exhibition of both classes of color in the presence of water we do not recollect to have met before.—*British Journal of Photography.*

CHEMICAL NOTES.

REAGENT FOR CARBOLIC ACID.—Four or five drops of a solution of 1 part of molybdic acid in 10 to 100 parts of concentrated suphuric acid are added to one or two drops of the liquid under examination in a porcelain capsule. If carbolic acid is present a light yellow or yellowish brown color appears, which changes to a chestnut-brown, and finally to a fine purple. The liquid to be tested must be dilute.

DETECTION OF INDICAN IN URINE.—Thirty c.c. urine are mixed with an equal volume of fuming hydrochloric acid in a test-tube holding 80 c.c., and warmed gently over the lamp. The addition of one or two drops of nitric acid makes the test more sensitive. The mixture, which has a brown color, is cooled by dipping the glass in cold water, covered with 2 or 3 centimeters of ether, and well shaken. If indican is present, the ether, when the liquid has become clear, will be found covered with a blue scum of indigotin. The subsequent addition of a few drops of alcohol renders the reaction more sensitive.—*Arch. Pharm.*

NITRIC ACID IN SPRING WATER.—Eder recommends for this purpose Tiemann's method as the best. This consists in evaporating down 1 liter at 150°, extracting with water, decomposing the filtrate with hydrochloric acid and ferrous chloride, boiling and receiving the escaping nitric oxide over soda-lye for measurement. Wagner's method is also applicable. It consists in destroying the organic matter with permanganate in a boiling alkaline solution, evaporation to dryness of the liquid previously freed from alkaline earths and from any oxalic acid which may have been formed, heating the residue mixed with soda and chromic oxide in a current of carbonic acid. The quantity of nitric acid is inferred from the quantity of chromic acid formed. This process cannot be recommended where nitrates are mixed with a large excess of organic matter.—*Zeitschrift Anal. Chemie.*

NEW ACIDIMETRIC AND ALKALIMETRIC INDICATOR.—Fresh-cut orange-peel is digested for twenty-four hours in a little alcohol; the volatile oil is removed from the yellow solution by treatment with ether and separated off. The tincture, on dilution with water, yields a colorless liquid, which is colored yellow by alkalies, and is not affected by acids. It gives accurate results in presence of ammoniacal salts.—*Zeitschrift Anal. Chemie.*

VALUATION OF ZINC-POWDER.—To determine the metallic zinc present—the only valuable constituent—Fresenius mixes about 3 grms. of the powder in a flask with sulphuric acid, and passes the hydrogen gas evolved through refrigerating and desiccating tubes into a combustion tube filled with cupric oxide. The water formed is absorbed in a U-tube two-thirds full of broken glass and containing 12 c.c. pure concentrated sulphuric acid. Nine parts of water correspond to 32·53 parts of metallic zinc.—*Zeitschrift Anal. Chemie.*

DERIVATIVES OF PYROGALLIC ETHER.—A. W. Hofmann.—The author treated the secondary ethers of pyrogallic acid with crystalline sesquichloride of carbon (C_2Cl_6). If the dimethylic ether is mixed with so much alcoholic solution of potassa as is required for the formation of its potassic salt, and sesquichloride of carbon is then added in such quantity that the chlorine exactly suffices to convert the potassa present into potassic chloride, and the mixture is heated for six to eight hours to about 130° preferably in a sealed tube, the liquid takes a deep indigo-blue color. This liquid is freed from alcohol by evaporation, the residue dissolved in water, any excess of carbon sesquichloride removed by filtration, and the liquid mixed with hydrochloric acid. The blue color changes to a light rose. The substance when purified forms yellow crystals which form blue salts with bases. It is probably identical with the substance obtained by Grätzel from beech-wood tar, and known as eupitton, and with Reichenbach's pitakall.

IGNITION OF HYDROGEN BY POWDERED ZINC.—In works where zinc chloride is obtained on a large scale by dissolving metallic zinc in dilute hydrochloric acid, violent explosions occur which have not been explained. M. P. W. Hoffmann thinks that these explosions are due to finely-divided zinc carried along to parts where the proportions of hydrogen and of atmospheric air form an explosive mixture. The brisk effervescence which ensues when a large quantity of zinc is thrown into dilute acid renders it possible for particles of zinc to be carried to a considerable distance. (Explosions are also said to occur occasionally when large quantities of finely-divided tin are treated with hydrochloric acid.—ED. *Chemical News.*)

ELECTROLYTIC DETERMINATION OF MERCURY.—E. W. Clarke.—A solution of mercuric chloride slightly acidulated with sulphuric acid was put in a platinum capsule connected with the zinc pole of a Bunsen bichromate battery of six elements. The wire at the end of the carbon pole terminated in a thin slip of platinum foil, which plunged into the solution. At first mercurous chloride was deposited, which gradually took the metallic state, and after the lapse of an hour there was nothing in the capsule but a pure mass of mercury, covered with a solution in which ammonia occasioned not the slightest turbidity. This liquid was withdrawn with a pipette, and water poured in its place a time or two before separating the connection with the battery. The liquid was then decanted off, and the mercury washed first with water, then with alcohol, and lastly with ether, and was then dried under the air-pump.

A NOTE on the effects of the vapors of sulphide of carbon has been submitted to the French Academy of Sciences by M. Poincaré. He placed some of the lower animals under the influence of the vapor in order to obtain some direct knowledge of the cause of the symptoms presented by men engaged in vulcanizing the caoutchouc of commerce. No excitation stage was shown by guinea-pigs and frogs; the effect of the treatment was to induce paralysis. Dissection revealed auricles swollen with dark blood, livid spots on the lungs, and, in some cases, the brain reduced to a pulp. The restriction of the use of vulcanized rubber to positively necessary purposes is recommended, and the employment of it as a material for toys is deprecated.

CHANGES IN CHLOROPHYL.

PROF. CHURCH, in some recent experiments on chlorophyl, has discovered the curious fact that purified chlorophyl, which on keeping and exposure to the air assumes an olive brown hue, has its green color restored, so that it becomes far more intense and characteristic in hue than the best sample of leaf green that he has ever seen, when heated in a water oven with four times its weight of zinc powder. That the chlorophyl is simply deoxidized and reduced to its original state, appears evident from the fact that the red fluorescence and spectral bands of its alcoholic solution are those of the unchanged pigment.

Another clew to the change of color of leaves in autumn, as well as to the deepening of their green tint in summer, thus presents itself for further investigation.

MEDICAL USES OF SALICYLIC ACID.

AT a late meeting of the Boston Society for Medical Improvement, Dr. Wheeler spoke of an eruption which he had observed follow the use of salicylic acid in rheumatism. It consisted of vesicles and pustules seen on both extremities. There was much sweating, and the patient died a few days later, of some complication. The eruption diminished after the discontinuance of the acid.

On the other hand, at a recent session of the Richmond, Va., Academy of Medicine, Dr. J. N. Upshur reported several cases of typhoid fever and scarlet fever in which he had used the above remedy with gratifying results. In cases in which temperature ranged from 103° to 104½°, by the exhibition of ten grains of salicylic acid in a saturated solution of phos. sodii every two hours, the temperature was reduced to 101°, above which it did not again rise. The above mixture was continued in the same doses every two hours for four days, then every four hours for six more days. The patient rapidly recovered. The case is from the *Southern Clinic*, for October.

Dr. B. W. Hazard writes, in the St. Louis *Clinical Record:*

Among the external uses of this acid, I take occasion to again refer to its employment in wounds, burns, and scalds. I usually prescribe it with cosmoline, in the proportion of ten grains to the ounce. Suppuration is reduced to a minimum, and the processes of repair go on without interruption.

I have found a solution of the acid in bay rum, ten to twenty grains to the ounce, a most effectual application in dandruff (*pityriasis capitis*), a half dozen or less times applied and the scales disappear. It is just as effective, and a far more agreeable application, than a solution of chloral hydrate.

In rheumatism the drug holds its place. Mr. E. Prideaux says, in the *Practitioner:*

The results of the treatment of acute rheumatism by salicylic acid are now almost fully determined, and from the great amount of recorded and accumulated experience of its action, its beneficial effect may be considered as proved. From an experience of about forty cases, I find that it cuts short the disease, so that it now lasts as many days as it did weeks formerly; it quickly reduces the temperature and keeps it down while the poison is eliminated from the system, if it does not have a specific action upon the disease itself, and by thus lessening the duration and intensity of the disease it lessens the probabilities of complications, more to be feared than the disease itself; and this it does in a way which cannot be hoped for by the use of any other remedy. It is true that a few failures have occurred in its use in the treatment of this disease, but in the larger number of these failure has evidently been due to timidity in dosing and in administering it frequently enough, for the drug is so rapidly eliminated from the system that unless its effects are kept up by hourly or very frequent doses for some time, it is not of much avail.—*Medical and Surgical Reporter.*

THE TREATMENT OF ULCERS WITH A SATURATED SOLUTION OF CHLORATE OF POTASSIUM.

By T. M. ROCHESTER, M.D.

I WISH to call attention to the treatment of ulcers, ulcerations, and suppurating wounds and sores in general, by the use of a saturated solution of chlorate of potassium. I have said suppurating sores in general, and so it will be found beneficial in all of these; but it is especially useful in that particular class of old, unhealthy, indolent ulcers which are one of the opprobia of our art. Let me describe briefly my plan of treatment in one of these cases.

Suppose, for example, a patient comes with an old, indolent ulcer on the leg, which is the most frequent situation. The sore is foul, unhealthy in appearance, and ill-smelling. The limb is usually much swollen, granulation is at a standstill, the ulcer may even be phagedenic, and the discharge is thin, sanious, and offensive. As a rule, the patient has the sore covered with some salve or ointment, and the limb is either bandaged tightly or strapped with adhesive plaster.

In a case of this kind I immediately remove all bandages and constrictions, and direct that they shall not be again applied. The ulcer is then carefully and gently washed with warm water, after which it is to be ordered to be gently douched five or six times a day with a saturated solution of chlorate of potassium; my usual prescription is: Take of pot. chloratis, 2 drachms; aquæ puræ, one pint. The best method of doing this is to fill a sponge with the solution, and then slowly press it out, holding it within an inch or two of the sore. After the ulcer has been quite freely douched, a thin layer of the unguentum zinci oxidi should be spread around the edges. It is then to be completely covered with a piece of oiled lint, kept in place by a bandage applied as loosely as possible. The douching should be repeated, at first, five or six times daily; the zinc ointment need not be used more than twice in the twenty-four hours. At the end of two or three days the ulcer will begin to assume a healthy appearance, and commence to granulate nicely. When this improvement is noticed, the number of douchings should be decreased—otherwise the granulations will become pale and flabby. As the sore fills up and begins to heal over around the edges, the zinc ointment should be increased, so as to cover the new skin. This serves to protect and strengthen it. So, too, it is well to continue its use for a few days after the ulcer has completely skinned over.

Such, in brief, is my mode of dealing with these cases; and it is with the keenest satisfaction that I have watched case after case of unhealthy, indolent, varicose, or specific ulcerations, which have defied one treatment after another, and worn out the patience of physician and patient alike, take on a healthy appearance after two or three days of this treatment, and thence proceed rapidly to a complete recovery. During the past fifteen months I have seen and treated by this plan between ninety and one hundred cases, and in no single instance have failed to see immediate and continued improvement, and, when they could be kept track of, complete healing in from one to six weeks.

This number of cases embraces not only the ordinary indolent ulcers, but also syphilitic, varicose, and one case which I believe was carcinomatous in its character.

Several of my cases had had scraping and skin-grafting tried in vain. Where they were syphilitic, constitutional treatment had been and was used alone without effect; but rapid healing immediately took place when the douching with the saturated solution of chlorate of potassium was combined with it.

There is another point that is worth mentioning, and that is, that this douching is entirely painless after a few applications. It may smart a little the first or second time, but even then it is so slight as not to be taken into consideration.

The author then describes a number of actual cases as successful examples of the treatment, and concludes as follows:

I do not know that I am right, but my theory is as follows:

1st. Its astringent properties cause it to repress exuberant granulations, or to stimulate their growth when they are absent or ill-formed.

2d. As an antiphlogistic it moderates the inflammatory action.

3d. And this I regard as the most important: as an antiseptic it destroys and prevents the growth of bacteria.

This threefold action, I believe, meets all the indications for the local treatment of this troublesome class of affections. In conclusion, let me say that this use of chlorate of potassium is not my own discovery, but was suggested to me while *interne* at the Monroe County Hospital, by the attending physician, Dr. Azel Backus, of Rochester, who has used this treatment successfully in his practice for years.—*Proceedings Medical Society County of Kings.*

REMOVAL OF MOLES.—The acid nitrate of mercury is recommended as effectual for the removal of moles. It should be applied with a splinter of wood in small quantity for a few seconds, carefully avoiding the sound skin. There is no pain of consequence, and the mole shrivels away and drops off in a few days.

THE TREATMENT OF DIARRHEA BY OXIDE OF ZINC.—Dr. Jacquier has followed, in the service of Dr. Bonamy at Nantes, the good effect of the employment of oxide of zinc in diarrhea. The formula which he has employed is the following: Oxide of zinc, 10 grains; bicarbonate of soda, 7½ grains; in four packets, one to be taken every six hours. In all the cases which he observed, oxide of zinc produced rapid cure of diarrhea. In fourteen cases observed by Pupgautier, the cure was even more rapid, since in only one case were three doses of the medicine required. The results are considered to have been more satisfactory, inasmuch as in several cases the malady had endured from one to many months, and other methods of treatment had not produced any improvement. Thus he concludes that, although by no means to be held as exclusive treatment, the employment of oxide of zinc deserves to be more generally known as useful in diarrhea.—*British Medical Journal.*

DEATH FROM CHLOROFORM. — T. Hughes, M.D., in London *Lancet* of November 2d, says: If I were about to be placed under the influence of chloroform, I would say, "Never mind my pulse, never mind my heart; leave my pupil to itself. Keep your eye on my breathing; and if it becomes embarrassed to a grave extent, take an artery forceps and pull my tongue well out." It was the observance of this simple yet all important rule that enabled the late Mr. Syne to say that he never lost a single case from chloroform, although he gave it in five thousand cases. Prof. Lister has done much to enforce this rule of practice, and to him is due the credit of pointing out the *modus operandi* of this proceeding. He was the first, as I am aware, who explained that its action is not mechanical, but is exerted chiefly through the nervous system.—*Louisville Medical News.*

TREATMENT OF DYSPEPSIA.

THE following is the treatment adopted at the Demilt Dispensary, New York, as described by Dr. D. Lewis, in the New York *Medical Journal:*

℞	Pulv. rhei	ʒ j
	Sodæ bicarb.	ʒ iss.
	Ol. menth. vir.	gtt. iv.
	Aquæ	ʒ iv. M.

Sig.—A tablespoonful before meals.

This alkaline mixture probably owes its efficacy to its stimulating action upon the gastric glands—a property of alkalies which has been amply demonstrated by many experimenters. When an additional laxative was necessary, a compound rhubarb pill was ordered at bedtime, or, what

is preferable in many cases, the pill of aloes, belladonna, and strychnia—

℞ Ext. aloes.....grs. ijss.
Ext. belladonnæ,
Ext. nucis vom.....*aa*, gr. ¼. M.
Sig.—One at bedtime.

In contrast with the above case are those patients who are anæmic, and complain of the symptoms common to that condition—loss of appetite, palpitation of the heart, intercostal neuralgia and headache. In some instances this condition is a natural sequence of prolonged dyspepsia, but is more commonly dependent upon other causes, such as bad hygiene, overwork, or malarial influences. Tonic treatment is here indicated, and the following prescription is usually effective :

℞ Quiniæ sulph.....gr. xij.
Tr. ferri chloridi.....℥iijss.
Aquæ.....℥iv. M.

Sig.—A teaspoonful in a wineglass of cold water, half an hour after meals.

An aloes and belladonna pill is occasionally required at bedtime.

Plasters have been often prescribed for intercostal neuralgia in these cases. Notwithstanding the prejudice against their use, experience here has proved them to be a valuable adjuvant in the treatment.

The belladonna plaster (4x6) is the one most frequently ordered, and next in order the capsicum plaster (same size), as now kept by druggists. A pitch plaster, with chloral hydrate sprinkled over its surface, was tried in several cases, but proved inferior to either of the others.

When there was irritability of the stomach (probably gastritis), with nausea and vomiting, a bismuth mixture was often ordered—

℞ Bismuth, subnit.....℥iv.
Acid. nitric. dil.....℥iij.
Tr. nucis vom.....℥jss.
Aq. menth. pip.....℥iv. M.

Sig.—A teaspoonful after meals. Shake well before using.

Since it has been pretty clearly demonstrated that bismuth acts mechanically by adhering to the mucous coat of the stomach, it is evident that a large dose should be administered. But the *very large* doses given by Lusanne, Menneret, and others (who gave ℥ j. per diem), no doubt hinder the excretion of gastric juice, thereby causing the cachectic symptoms which those observers found to follow its prolonged use.

DISINFECTANTS, AND THEIR SPECIAL APPLICATION.

[From a paper by E. L. GRIFFIN, M.D., President State Board of Health of Wisconsin.]

DISINFECTANTS are naturally divided into three classes:

1. *Those which chemically destroy or effectually restrain the contagious and infectious virus.*
2. *Agents that arrest chemical changes and check the fermentative process—antiseptics.*
3. *Deodorants and absorbents—agents that destroy putrid exhalations and physically restrain noxious compounds.*

1. FRESH STONE LIME.

Application.—To absorb moisture and putrid fluids.

How used.—Pulverized and scattered over places to be dried. In damp rooms, it should be placed in pans in liberal quantities. Mixed with water, it is used to limewash walls and ceilings. It is useful when spread over heaps of fresh manure as a preservative.

2. PULVERIZED CHARCOAL.

Application.—To absorb putrid gases.

How used.—Mixed with an equal part of fresh lime, it forms the "calx powder" of the shops.

Thus combined it can be spread liberally over heaps of putrescent matter. It can be strewn in alleys, gutters, and moist places, where foul gases are generated and disease producing germs are likely to be found.

To deodorize a privy, which contains only solid matter, this mixture is very effective.

When well, river, or cistern water becomes impure from the presence of organic matter, and acquires a slightly putrid or sulphurous odor, it should be rejected; but if necessity compels its use, it should be disinfected. The only agent suitable for this purpose is charcoal well pulverized. This should be placed in layers, between clean gravel or broken quartz, and the water filtered through it. It is necessary that the charcoal should be frequently renewed, for its efficiency depends upon its absorbing power, and it becomes inert, when saturated.

3. CHLORIDE OF LIME.

Application.—To destroy putrid gases and check putrefaction.

How used.—A solution of chloride of lime made by straining or decanting a gallon of water into which a pound of the lime has been dissolved, is a good disinfectant fluid to use in washing the bodies of those who have died of small pox, cholera, scarlet fever, measles or any other disease. It is a good solution to use in the sick room for cleansing the hands of the nurse, and into which small articles can be immersed which are awaiting an opportunity to be boiled.

To generate chlorine gas, pour strong vinegar or dilute sulphuric acid upon chloride of lime placed in pans in the room. Or, place in an earthen vessel four ounces of peroxide of manganese and pour upon it one pound of muriatic acid.

Chlorine gas is regarded as an efficient disinfectant, but it must be efficiently applied. It is very efficient in disinfecting confined or infected atmospheres and porous substances. Its rapid diffusion and power of penetration are great. It destroys sulphureted hydrogen, ammonia, and all fetid organic compounds. Its odor penetrates far beyond its power as a disinfectant, hence its real degree of influence may be deceptive. It can appropriately be used in disinfecting ships, ship baggage, foul cellars, and rooms unoccupied.

4. DRY EARTH.

Application.—To absorb effluvia from decaying animal and vegetable matter, and appropriately, human excreta.

Dry earth is nearly a complete disinfectant, if used in sufficient quantities to absorb all moisture. It is especially applicable to the deodorizing of privy contents, where the basin is shallow, with a limited quantity of fluid. It should be abundantly applied.

5. SULPHUROUS ACID GAS.

Application.—To disinfect rooms and infected clothing. Applied only in case of unoccupied rooms. To be effectual in destroying disease germs, the fumes must be so strong that they would destroy human life.

How used.—Place in an earthen vessel or iron kettle containing a small quantity of ashes, a few live coals, upon which place from one to four pounds of sulphur, in powder or fragments, according to the size of the room. A room containing 2,000 cubic feet of space would require about four pounds of sulphur, or one and one-half ounces to each 100 cubic feet of space.

To guard against accident by fire, it is well to place the vessel upon a flag or suspend it over a tub of water. As soon as the sulphur is ignited, the room, having previously been rendered tight, should be closed and remain closed for twelve or twenty-four hours. It should then be thoroughly ventilated by opening chimney draughts, windows and doors; after which it should be scrubbed, the ceilings limewashed, and the walls repapered.

6. NITROUS ACID FUMES.

Application.—Same as sulphur fumes.

How used.—By pouring over one ounce of copper chips or filings, placed in a deep jar, three ounces of concentrated nitric acid.

The fumes are rapidly generated, and are so dangerous to life as to render this process of disinfection objectionable. It should never be practiced excepting as personally supervised by an intelligent physician or a competent and responsible health officer.

7. SULPHATE OF IRON (COPPERAS).

Application.—To disinfect privies, cess-pools, drains, sewers, and all vessels and places receiving the discharges of the sick. It decomposes the sulphureted hydrogen and the ammoniacal compounds so poisonous and offensive in privy vaults.

How used.—Dissolve eight or ten pounds of the copperas in eight or ten gallons of water. Add to this solution one pint of the impure carbolic acid. The solution will be rendered more complete if hot water is used.

This solution can be freely used. A privy which accommodates an ordinary sized household will require, at least, one-half of this quantity every two or three weeks, during the hot summer months. A smaller quantity can be poured daily into the vault, also into the water closets, waste pipes, or sink drains.

8. PERMANGANATE OF POTASSIUM.

Application.—To disinfect temporarily soiled articles from the sick room until they can be boiled or washed.

It should not be used in connection with carbolic acid. This article forms the principal ingredient in "Condy's Disinfecting Liquid," of the shops.

Articles should be immediately boiled upon removal from this liquid.

The solution should be made by dissolving one ounce of the permanganate in three gallons of water.

9. CHLORALUM AND BROMO-CHLORALUM.

According to analysis of these compounds, the most valuable element they contain, and the one to which they owe largely their disinfecting property, is the chloride of aluminum, which of itself is a very efficient disinfectant.

How used.—Dilute with eight or ten parts of water and place in vessels in the sick room, or saturate towels with the diluted solution and hang them in the sick room. It is well adapted to the sick room, as it possesses the advantage of being odorless.

10. CHLORIDE OF ZINC. SULPHIDE OF ZINC. SULPHATE OF ZINC.

Application.—These salts of zinc are used in solution precisely the same as the permanganate of potassium is used. They are all poisonous, but are regarded as good disinfectants. The solution needs to be made strong—two ounces of zinc to each gallon of water used. If the solution is very strong, damage may result to the clothing immersed in it. Articles immersed in these solutions should be boiled without much delay.

These solutions are especially adapted to the disinfecting of sewage.

11. SULPHATE ZINC, EIGHT OUNCES—(CRUDE) CARBOLIC ACID, ONE OUNCE—WARM WATER, THREE GALLONS.

This compound is well recommended by the Board of Health of the city of New York, as a disinfectant. It is a convenient preparation to use in the sick room.

12. IODINE.

Application.—For the deodorization and disinfection of fluid and semi-fluid substances undergoing decomposition, iodine is well recommended.

It is claimed to have a destructive influence over the virus of small-pox, for which purpose it can be exposed, in small quantities, upon a plate in the room.

A solution of iodine, two grains; iodide of potassium, twenty grains, and water, four ounces, kept in an open vessel, at a high temperature, has been employed in the sick room of scarlet fever patients as a useful disinfectant.

13. CARBOLIC ACID.

Application.—Mixed in the proportion of one part of acid to from forty to one hundred parts of water, carbolic acid has a wide range of application as an antiseptic and disinfectant.

For purposes of thorough destruction of disease germs, a solution of not less than two per cent. of the acid should be employed. When used to disinfect clothing, a solution of one part of the acid to one hundred of water would be an appropriate strength.

To guard against damage to the clothing by the contact of particles of undissolved acid, a quantity of strong vinegar, equal to the amount of acid used, should be added to secure its complete solution in the water.

Disinfection in a room, as is almost always practiced with a spray of carbolic acid, is a mere deceptive procedure. The quantity used is too small to produce any effect upon the specific contagion.

14. OZONE.

This substance exists normally in the atmosphere, and is believed to destroy the impurities of the air. It is an intensely oxidizing agent, and is regarded as a deodorant rather than a disinfectant.

The atmosphere would be so polluted by its admixture with the noxious matters evolved during the putrefactive changes which are unceasingly taking place on the globe, as to be unfitted for sustaining animal life, were it not for the all-pervading influence of the great disinfectant, ozone.

It has forty times the bleaching power of chlorine and is regarded as the most energetic constituent of the atmosphere.

DISCOVERIES IN WESTERN CAVES.*

By REV. HORACE C. HOVEY, M.A.

THE following notes are selected from a large mass of descriptive material collected by the writer during recent underground explorations in some of the States of the Mississippi Valley:

1. *Silurian Caves.*—Especial attention was paid to these caves in view of the "grave doubts" of a distinguished geologist "whether in a single case they extend much beyond the light of day."† His remark refers to the upper hundred feet of the Cincinnati group. An excellent opportunity for the study of caves in this Lower Silurian rock is afforded in bluffs about Madison, Indiana, which rise 400 feet from the thin strata characteristic of that formation to the massive rock of the Niagara limestone. Each stream as it plunges down from the table land above washes out the lower layers, leaving the upper as an overhanging ledge. In time the shallow grotto behind the cascade expands into a spacious amphitheater 200 or 300 feet wide and nearly as many deep. The roof generally falls by its own weight when these dimensions are exceeded, and the result is finally a ravine with steep walls encumbered below with large fragments of stone. An examination of the region for twenty miles north of Madison led to our discovering, not only sinks, natural wells, rock houses, and water swept chasms, but also true caverns, whose roof is the solid limestone of the Upper Silurian, while the excavation itself is in the softer rocks of the Lower.

Two miles west of Hanover, Indiana, is a stream that flows toward the Wabash from the very banks of the Ohio. It emerges from a tunnel which is easily threaded for half a mile, and continues uncovered for fifty feet, and then it again recedes by a second opening. We followed its course through roomy halls rich in stalactites to a waterfall fifteen feet high, where the exploration terminated. The entire distance traversed was by estimate one mile and a half, a greater length than that of Weyer's Cave.

The credit of discovering this *Silurian* cavern belongs to Messrs. Monfort and Thomson, and, as it is now for the first time described, it may be appropriately named the Hanover Cave.

2. *Sub-Carboniferous Caves.*—The procedure of the brook described above is reversed in the case of Lost River, which after receiving tributaries and increasing in volume, flows *into* a cavernous opening, and continues for miles along a subterranean channel, alternately rising to the surface and sinking again several times before it finally emerges a mile below Orangeville, Indiana. These "rises," as they are called, are generally marked by gulfs denoting the fall of superincumbent rocks. At one of them a small boat has been put upon the stream, it having been found to be navigable for a long distance under ground. Lost River flows amid bluffs of the St. Louis group, carved by erosion into numerous ravines and sink holes, and the latter so thoroughly underdrain the region as to cause a remarkable absence of springs, brooks, and ponds.

These phenomena are instructive as to the production of the countless caves that honeycomb the sub-carboniferous rocks of Kentucky and Southern Indiana. A compact and homogeneous limestone, varying from 25 feet to 440 feet in measured thickness, lies between the surface and the level of natural drainage, subject to the dissolving and eroding action of running water. The result in time is a succession of arches, galleries, and avenues, presenting wonderful and grotesque combinations to the explorer when the stream that has caused them is withdrawn to some other channel. The slow trickling of lime water furnishes materials for the growth of stalactites that tend to gradually close up and obliterate these deserted halls. Should Lost River find another channel, the cave which would remain might equal in proportions any hitherto discovered.

There are no doubt numerous unexplored and nameless caves that would richly reward those whose love of adventure should lead them to follow out their ramifications. Professor Shaler estimates that in Kentucky "there are at least 100,000 miles of open cavern beneath the surface of the carboniferous limestone;" and my own observations lead to the conclusion that there are thousands of miles of such subterranean avenues beneath the same formation in Indiana. Yet the public should be cautious in yielding credence to cave stories.

Articles appeared in Louisville papers less than a year ago, and were copied and believed in this country, and even found their way into foreign periodicals, that purported to describe the "Grand Crystal Cave, near Glasgow, Kentucky," giving thrilling particulars of a perilous voyage on its mysterious waters. We ascertained by inquiry on the spot that no such cave exists, and have learned by experience that cave streams are generally very safe and placid bodies of water, by reason of the fact that they are not of navigable size until the level of adjacent streams is nearly reached.

3. *Mammoth Cave* is visited by more than 2,000 persons annually, and its noteworthy features have been repeatedly described. Tourists are usually content with either the short or the long route, both of which can be traversed in a single day. We, however, were favored with a special guide, and devoted many successive days to localities not often visited. After eighty miles of underground travel our curiosity was satiated, and yet we had entered only 54 of the 225 avenues reported by Professor D. D. Owen as actually enumerated.

The comparatively recent discovery of a pit-like passage, called "The Corkscrew," is of importance, not only because it enables the visitors to cut off two miles between the Rotunda and River Hall by an abrupt descent of 150 feet, but also because it proves the theory that the cave crosses its own track, so that a change is required in the entire map. It is now believed that the cascade falling over the mouth and instantly sinking through the rocks is identical with that at the head of the River Styx, and is a feeder of that stream. It is also proved that these deep and navigable rivers, instead of being fed by Green River, flow into it. Chaff thrown upon the surface of Lake Lethe reappears after some time in the waters of what is known as the Upper Big Spring,

* *American Journal of Science and Arts*, Dec., 1878.
† Geological Survey of Kentucky (Shaler), vol. i., p. 4.

while that thrown upon Echo River comes out at the Lower Spring.

The fact that Green River is thus replenished, explains the peculiarity of its never being frozen over even in the coldest winter. It may be added that, as the water level is known to be 312 feet below the crest of the hill covering the cave, the subterranean rivers must be at a little less than that number of feet beneath the surface, and must also be the lowest localities possible, hence no dome in Mammoth Cave could exceed 312 feet in height without cutting through to the open air, by which test may be corrected the statements of those imaginative writers whose estimates are nearly double what they should be.

The grandest of these vertical cavities, piercing from some sink hole above through all the galleries down to the water level, is called by way of eminence the Mammoth Dome. Beyond it lies a stately hall, so like the ruins of Karnak and Luxor, that we had permission to name it the Egyptian Temple. Here stand six columns of oolitic limestone, incrusted with a stalagmite coating but an inch or two in thickness and as yellow as jasper. We measured one that arose eighty feet from what we regarded as its base to the ceiling, and found it twenty-six feet in its longest diameter. Descending into a pit, we found what we named the Catacombs, opening into an avenue about three miles long.

The acoustic properties of Echo River passage way are extraordinary. This body of water is said to be rather less than one mile in length and to be forty or fifty feet deep. The continued arch of natural masonry by which it is spanned varies in height from three to thirty feet. The echo is a musical prolongation of sound, rather than a distinct repetition of words, although this also may be obtained. Harmonics were produced in response to certain keynotes. A strong vocal impulse was prolonged with sustained vigor for fifteen seconds, and in the opinion of others for a longer time, the duration depending much on our location on the water, the purity of tone, the pitch and the energy of the original aerial vibrations. By silently but forcibly pushing the water to and fro with a broad paddle, successive wavelets were sent into numerous marginal cavities, awakening chimes that continued for from three to ten minutes, according to the violence of the agitation, dying away as the river regained a state of quiescence.

The average temperature of the cave has long been reported incorrectly to be 59° Fahr. Temperature observations were made by us in all parts of the cave that we visited, using a thermometer from the Tower Company, Chester, Pennsylvania, which indicated 88° in the hotel office (August 19th, 1878), and 66° at the cave's mouth. We were careful to suspend the instrument by its ring in each instance, and to hold it at a distance from the person and the lamp, particulars about which others may not have taken sufficient pains.

The mercury stood highest in the Rotunda, where it reached 58°. The lowest temperature was found in Lucy's Dome, namely, 54°. It was 57° in three places, but in forty-two observations the mercury stood at 56°. The water in all the rivers was also at 56°, instead of at 54°, as often stated. In three springs the mercury fell to 53°, and in one, Richardson's Spring, to 52°, which was the lowest degree marked anywhere. The temperature of the rivers is identical with that of the atmosphere over them, the apparent difference being due to variation in conductivity. The average temperature of the cave may be fixed at 56°.

4. *Wyandot Cave.*—The entrance to Wyandot Cave is in Crawford County, Indiana, half a mile from Blue River and five miles from the Ohio. A map of the cave was prepared by Dr. Talbot in 1852, revised by me in 1854, and published in Owen's Indiana Geological Report in 1860. A new map is shortly to appear, noting corrections and recent discoveries. The length of the cave is twenty-three miles, including all the avenues. It has many fine halls and domes, the largest of which has a circumference of 1,000 feet, and is said to be 205 feet high. The name has hitherto been Mammoth Hall, but it is now renamed Rothrock's Cathedral, to avoid confusion, and also as a tardy recognition of the worthy man who originally purchased the place from the government, and left it as a heritage to his sons.

Wyandot Cave should be visited even by those who have already explored the greater cavern of Kentucky, for it is far richer in stalactitic ornamentation, although less abounding in gypsum rosettes or "oulopholites." The stalactites are of the fine grained, translucent kind often called alabaster, and much resembling the Mexican onyx.

Thermometrical observations, made by the same instrument and methods used in Mammoth Cave, showed that, while the temperature of the outer air was 76°, that of Wyandot Cave averaged 55½°. The highest temperature was found in the Pillared Palace, 57°; the lowest, in the Wyandots' Council Room, 54°; elsewhere, out of twenty-two observations, an equal number indicated 55° and 56°. In two springs the water was found to have a temperature of 53°, and in one, of 54°. Thus, instead of being, as has often been said, 6° colder than Mammoth Cave, we found it only half a degree colder.

An important discovery was made last April by a party of students from Wabash College, led by Mr. C. E. Milroy. Forcing their way through a low, narrow passage for fifty feet from a locality marked on the map as the Rugged Pass, they entered a realm of chaos named, after its discoverer, Milroy's Temple. Pits, miry banks, huge rocks are overhung by galleries of creamy stalactites, vermicular tubes intertwined, frozen cataracts, and all, in short, that nature could do in her wildest and most fantastic mood. Among the many curiosities of this extraordinary place is a row of musical stalactites, very broad and thin, on which a chord can be struck or a melody played by a skillful hand.

This discovery has stimulated research. We ourselves followed the guide through a trench dug by him in a clay bank into a chamber where the floor was thickly strewn with charred fragments of hickory bark, and two torches long extinct were sticking in a crevice in the low ceiling. The tracks of some wild beast were also found, which led us to name the place the Wolf's Lair. The roof seems to have fallen in since the torches were left here, and our compass told us that the closed avenue must have led to Banditti Hall, within 1,200 feet of the mouth. Animals of various kinds are known to have frequented this cave in former days. We saw the skeleton of an opossum and also of a wild cat, besides many stout poles, from five to eight feet long, marked by sharp teeth in some ancient contest. "Bear slides" are shown in several places where the rocks are blackened and polished as if by the rubbing of fur. "Bear wallows" are also pointed out, but, on our recent visit, we discovered this to be a misnomer.

Bands of black flint are found in the limestones of the south arm of the cave, sometimes in continuous belts, but oftener in rows of nodules varying in size from one to ten inches. Occasionally they have a geodic form and a crystalline center, showing that the silicious particles had collected about a fossil nucleus. Between these belts or rows is usually a chalky substance easily cut with the knife or even by the finger nail. The so-called "bear wallows" are where the flint is most abundant and of the best quality, as near the Pillared Palace.

Beside each depression is a pile of ashes with bits of hickory bark. Digging into the wallow, quantities of flint chips were brought to light. Piles of flint blocks abound in which were hundreds of them, each piece having parallel faces, and averaging four inches in length, one or two inches in width, and one half inch in thickness. It was evident to me that they were split by the Indians from the oval nodules as materials for arrow tips or spear heads. We found quartz pounders with which the splitting may have been done, but no manufactured articles, except a small saucer, cut from sandstone, which had once held some black substance. The place was plainly a mine, and not a factory. Our search at the mouth of the cave was rewarded by the discovery of quantities of flint chips, and also a number of finished arrow heads.

Indian foot-prints were visible in all parts of the new cave when first explored, and I saw them in 1854, although now they are obliterated. The cane torches, so abundant at "Chief City" in Mammoth Cave, which were supposed to be filled with bear's fat when ready for use, are rarely found in Wyandot Cave, which seems to have been lighted by bundles of hickory bark ignited by splinters of various kinds of wood.

What is known as the "Old Cave" was worked by saltpeter miners in 1812, and sundry acts of vandalism have been charged on them, which, it is more probable, were done by the aborigines. The finest stalacto-stalagmitic column probably in the world is the Pillar of the Constitution at the end of the Old Cave, three miles from the mouth. It is 40 feet high, and 25 feet in diameter, and it rests on a base 300 feet in circumference. The weight of this immense mass of alabaster caused the subjacent rocks to settle, and this in turn cracked the base, opening crevices many yards long, and varying in width from two inches to one foot. A large segment has been cut from the base of this column.

Starting from the crevices, an excavation was made, cutting a mass from the base having an arc of thirty feet, and making a cavity into the pillar itself ten feet wide, seven feet high, and five feet deep. This excavation has hitherto been regarded as a deliberate plan of the miners to fell the column.

But we have a different explanation to offer. Tracing the right edge of the cut, we find it running underneath a stalagmitic wrapping eight feet wide and ten inches thick at its thickest part. Inspection shows that drippings like those now healing this wound were at work before it was inflicted, and that the incision was made through a mass similar to that by which it is at present overlapped. Rothrock's experiments, carefully carried on for a long term of years, fix the rate of stalagmitic growth in this portion of the cave at one inch a century,* hence the excavation, instead of being made in 1812, must have been completed a thousand years ago. Its age may exceed that, and it cannot be much less. Following the talus of pure white stones that have rolled down under the ledges of black limestone, we find them sometimes cemented over a cavity where nature has had time to produce groups of exquisite stalactites since the quarry was worked, confirming the explanation above given.

Further search enabled us to discover the tools with which the ancient workmen wrought, whoever they were, namely, numerous round or oblong granite bowlders, extremely hard, and of a size suitable to be grasped by the hand or twisted in a withe and swung as a maul. They could not have been carried to the end of the cave by the action of water, for it is twenty feet higher than the mouth. The region, moreover, is south of the line of glacial drift. It seems certain, hence, that they were brought from a distance by persons having access to no better tools. Their ends also are battered and whitened by use as pounders.

No manufactured articles were found on the spot, and only shapeless disintegrated fragments were upturned at the mouth of the cave. It is our conclusion that from this alabaster mine blocks of a convenient size were carried away, perhaps by successive generations, as a choice material for ornaments and images. Those who wrought here by torchlight may have been of the same race that dotted the Ohio Valley with mounds, and whose era, according to Mr. C. C. Jones (Mon. Remains of Georgia, p. 59), was synchronous with the date of the mine as estimated in this article. Ornaments of alabaster have been repeatedly exhumed among Indian relics in the Southern States, and more careful research may find similar objects amid the tumuli of Indiana, though perhaps not abundantly, for alabaster, though a very durable material, when not exposed to the elements, is fibrous in its nature, and would be liable to decay amid the frosts and sunshine of ten centuries, as we know from the crumbling specimens found outside in the vicinity of the cave.

* Dr. Binkerd's estimate of stalagmitic growth in Mammoth Cave fixed it at one inch in 7,500 years, which makes Rothrock's estimate seem very moderate indeed. (See Binkerd's Mammoth Cave, p. 54.)

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RECORD OF RECENT SCIENTIFIC PUBLICATIONS.

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MEDICINE AND CHEMISTRY.

"Leisure Time Studies, chiefly Biological." By Andrew Wilson. Chatto & Windus, London.

"On Gastro-Elytrotomy." By H. J. Garrigues, M.D. D. Appleton & Co., New York.

"A Treatise on Chemistry." By Profs. Roscoe & Schorlemmer. Vol. II. Metals. Macmillan & Co., New York.

"Section-Cutting. A guide to the Mounting, etc., for the Microscope." By Sylvester Marsh, M.D. Lindsay & Blakiston, Philadelphia.

MECHANICS AND ENGINEERING.

"The Bridges of North America. A Comparison of the American and European Systems." Translated from the French of L. A. Camoli, C.E., by S. H. Shren, C.E. D. Van Nostrand, New York.

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"Pocket Book for Chemists, Metallurgists, Dyers, Brewers, Photographers, etc." By Thos. Bayley. E. & F. N. Spon, New York.

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"The Pyrotechnist's Treasury; or, The Complete Art of Making Fire-Works." By Thos. Kentish. D. Van Nostrand, New York.

NEW SERIALS.

"The American Journal of Otology. Quarterly Journal of Physical Acoustics and Aural Surgery." Edited by Clarence J. Blake, M.D. No. 1, Jan., 1879. Wm. Wood & Co., New York.

"The American Quarterly Microscopical Journal." R. Hitchcock, Editor. No. 1, Oct., 1878. Hitchcock & Wall, New York.

A NEW FRUIT HOUSE.

MR. H. C. HOAG, of Lockport, N. Y., and Mr. G. P. Hosmer have been building a fruit house the past season. The building is 120 by 40 feet and five stories high—two of the stories being below the surface of the ground, made by blasting out the hard limestone rock which underlies that city. The walls of the building are double; the outer wall being constructed of the stone taken out of the excavations, and the inner wall being of bricks. The floors of the three upper stories are of strips, laid at a small distance apart, to allow of free circulation of air through the building. One room, 32 by 40 feet, is floored solid, for work-room and office. The ceiling of the upper story is of matched stuff, and nailed directly to the rafters. A water engine on the lowest floor runs the elevator, by which barrels of fruit are hoisted or lowered to any floor. The elevator carries eight barrels at a time. The capacity of the building is 19,500 barrels, and there are now in store about 15,000 barrels.

Great pains have been taken with the ventilation of the house and with the means of regulating the temperature. Three openings in the front and rear of the building, underneath the bottom floor, admit sufficient quantities of air, which can be excluded at any time by covers which can be closed by cords running from the office on the street floor. On each side of the building are three open spaces between the brick and stone walls, about three feet in width and four inches deep, extending from the bottom to the top of the building. On each floor holes are cut through into these draught flues, which carry off all the stagnant or foul air in the rooms. Gas pipes extend throughout the whole building, so that men can work in any part of the fruit house without opening the shutters. The windows in the front and rear of the building have double shutters. In front, under the sidewalk and extending the whole length of the front, is an open space of about four feet to allow the air to pass into the draught windows, which have wooden covers to exclude it when necessary. The draught windows have iron guards and net sieves to keep out vermin and dirt which might be drawn in by the suction.—*Country Gentleman.*

AUSTRALIAN SUGAR.

SUGAR-PLANTING in Australia is attaining some importance. Mr. Newcombe, Government Statist for New South Wales, reports that the gross quantity manufactured in the statistical year 1877–78 amounted to 150,744 lbs. against 93,960 lbs. in the previous year—or an increase of 60 per cent. This result is very gratifying, as an indication that the industry is remunerative and is likely to take an important position in the colony. Not only in New South Wales, but in Queensland, in the Northern Territory of South Australia, and in Western Australia, all of which are favored with a climate and soil even better adapted than those of the older colony for sugar-planting, large tracts of land are already devoted to the cultivation of the cane, and every year sees an addition to the capital invested and to the area under the crop. In Queensland, for instance, about 25,000 acres are planted with sugar-cane, the produce of which is very nearly 16,000 tons of sugar a year.

A GERMAN chemist, Dr. Paagel, has been inquiring as to the effect of frost on fodder plants (cabbage plants, etc.) and the best mode of utilizing frozen plants. The principal change effected by the frost he finds to be a formation of sugar from starch-flour; and as sugar has a nutritive value corresponding to the quantity of starch-flour from which it has been produced, he considers that no reduction in the nutritive value of the plants occurs through freezing. Care must be taken, however, about the delivery of the frozen plants. First, they should not be given in the low state of temperature they possess, and then they must not be allowed to lie long after thawing, else (probably from the formation of diastatic ferments) they pass into putrefaction, and so may easily do harm. They are probably best used when given as fodder immediately after thawing or after preparation by steeping in hot water or steaming. A long time after thawing frozen plants cannot be given as fodder without danger.